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MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

SEPTEMBER, 1830.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MAY, 1830.

With Remarks and Exemplifications, by the Editor.

(Concluded from page 85.)

31. For a *Machine for Thrashing Rice;* Jehiel Butts, Georgetown, South Carolina, May 20.

It was the machine generally used for thrashing rice, which probably suggested the construction of most of our thrashing machines, the main acting part being a cylinder with beaters. In Mr. Butts' machine, two cylinders are used instead of one; these stand one over the other, the grain passing between them, and being therefore acted upon both above and below. The sheaves are opened, placed upon an inclined board, and pushed forward between the cylinders, which revolve with great rapidity. Revolving rakes then draw the straw onward over wire screens, which suffer the grain and chaff to pass through upon an inclined board, down which it is carried to a revolving fan.

That for which the patent is taken appears to be the two revolving beaters, striking the rice on both sides.

32. For an improvement in the art of *Manufacturing Seine Twine by Machinery;* The Petersburg Manufacturing Company, assignees of the inventor, Alston Pond, of Petersburg, Dinwiddie county, Virginia, May 20.

On the 21st day of April, 1829, a patent was obtained by Mr. Pond for machinery having the same object in view with the present;

this we noticed in due course. The machinery now patented acts somewhat on the same principle with the former, but appears to be more simple and compact. We shall not attempt to describe it, for the same reason which interfered with a description of the first machine, namely, that it could not be done without drawings. The claim is to the particular mode in which a double motion is given to the bobbins containing the yarn; that is, a horizontal motion to give the twist, and a vertical one to deliver the yarn to be laid.

The instrument is well described, and neatly and distinctly drawn; and we think the object of the patent clearly set forth.

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33. For an improvement in the mode of *Making Pails, Tubs, &c.;* Palmer Phillips, Busti, Chautauque county, New York, May 20.

This patent is taken for a method of jointing the staves of tubs and buckets, so as at once to give the right slope, or cant to their edges. A trough is made in which the jointer is to be worked backwards and forwards by hand; the iron is on one side of this jointer, and placed obliquely. Through the side of the trough a long mortise, or slot, is made, to admit the edge of the stave to come in contact with the jointer. The stave is supported on two rests on the side of the trough, and flush with the lower edge of the slat. These rests are hollowed to receive the stave, and can be raised or lowered by means of a screw, to adapt them to the staves of vessels of different sizes. When properly adjusted, any number of staves may be jointed, and will come correctly together, whether narrow or wide. The claim is to the foregoing machine, which is very much like a common shooting board.

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34. For an improvement, design, or plan, for the purpose of *Giving instruction in the valuable arts of Reading, Drawing, and Writing*, whereby persons of any age, but particularly children and youth, may be enabled to instruct themselves, as well as to be instructed by masters, or teachers, in those arts, called "Varlé's Self-instructor;" Charles Varlé, Baltimore, Maryland, May 20.

Numbers, pictures, and names, are engraved in columns, and printed on foolscap, or other paper; the arrangement being as here represented.

CIV. 104	hat.			Hat.
CV. 105	house.			House.

The child, or other pupil, is to be taught the figures and the words; is to write them in the blank spaces; is to pass a dry pen over the outlines of the drawings; and is then to draw them in the spaces left for that purpose.

This is very much like many of our primmers and spelling books, and still more like some of those prepared for teaching the deaf and dumb. The patentee has given particular directions for proceeding with his *discovery*, or *invention*, but has not told us in what part, or parts, the novelty consists, a task which, fortunately, we are not called upon to perform. If he is successfully employed in teaching, we wish him fame and fortune, as we honour his pursuit; but do not, however, anticipate that any large portion of this fortune will be derived from the sale of his patent rights, or patent books.

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35. For an improvement in the *Piano Forte Action*; Charles Saltonstall Seabury, City of New York, May 20.

This patent is taken for a mode of applying the action above the strings, in the common horizontal piano forte. It is contemplated, however, to apply the same kind of action to the upright, and grand piano, and to other stringed instruments, and the claim is to the action generally.

Messrs. Loud and Brothers, of Philadelphia, obtained a patent for such an arrangement of the action of horizontal piano fortes as should cause the hammers to strike the strings in the direction in which they are supported by the bridges. This patent was obtained on the 15th of May, 1827, and the specification may be found at p. 62, vol. iv. first series.

If the Messrs. Loud can sustain their claim to the particular object which they specify, the claim of the present patentee will conflict with theirs, as one of the modes proposed by them was the placing of the action above the strings, without regard to the particular arrangement of the action in other respects.

The plan of placing the action above the strings, if our information be correct, has been followed in some of the German manufactories.

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36. For a *Machine for Washing Clothes;* Andrew Kirkpatrick, Urbana, Champaign county, Ohio, May 21.

The claim is to a "curved bed and rubbers," applied in a way fully justified by prescription.

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37. For an improvement in the *Plough;* Charles Rawling, Spring Mills, Centre county, Pennsylvania, May 21.

We are told that "the mould board is made of cast iron of a suitable curve," that "the land side is made of the usual form," "the share is made of wrought or cast iron," "the coulter is made of wrought iron, and of a *certain* curve to prevent its clogging," "the handles are made of wood, and of the usual shape." And the claim is to "the form of the share, and the manner in which it is fastened

to the mould board, by screws, bolts, and nuts, screwing on the lower side of the same." It is well to make ploughs of *suitable* and *certain* forms, and to employ the ordinary materials, as the present patentee proposes; the screws, bolts, and nuts, which screw the whole together, appear to form the subject of the patent.

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38. For a *Machine for Washing Clothes;* James M. Gates, Norwich, New London county, Connecticut, May 21.

The patentee claims "the arrangement and putting together of the various parts which constitute the same in the [machine] above specified; and the application thereof, and the powers and principles embraced in the operation of said machine, in the form and method above set forth and described, for the purposes of washing clothes." We cannot tell, because we do not know, what are the new powers and principles intended, as they are neither well described or represented; the various parts appear to us like the parts of various other washing machines, excepting that the vibratory motion of the dasher is effected by means of ropes, in what appears to be a very inconvenient way.

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39. For a *Machine for Cutting Paper, Books, &c.;* Francis B. Howell, Lockport, Warren county, New York, May 21.

This machine strongly resembles that patented by Mr. John M'Clintic, of Chambersburg, Pennsylvania, March 31st, 1827, which operates by bringing, by means of a lever, a straight knife or cutter down upon the ream of paper, &c. to be cut. In the present machine, instead of a straight knife, the one used is bent twice at right angles, so as to cut the three sides at one operation. The claim is to "the above described knife, containing three cutting edges, either stationary, or moveable."

We doubt the superiority of this to the former mode. It will be difficult so to form the knife as to make the corners of the paper perfectly sharp; and it will be still more difficult to keep such a knife in order; besides these objections, every particular size of paper must have its appropriate knife.

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40. For an improved mode of *Laying the Foundations of Marine Rail-ways,* under water; James Ronaldson and John Lindsay Neill, Philadelphia, Pennsylvania, May 22.

(See specification.)

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41. For *Making or Manufacturing Felt,* or a substance in nature thereof, applicable to covering the bottoms of vessels, and other useful purposes; Thomas Robinson Williams, of Newport, Rhode Island, now in London, May 22.

Different fibrous materials, such as hair, wool, cotton, hemp, flax, &c. are to be spread evenly upon a web of woven wire, by a card-

ing machine, blowing machine, picker, or any other means. This web of wire forms an endless apron, passing over rollers. Over this a second apron of wire is placed, which likewise passes over rollers; this latter apron is, however, much shorter than the former, the rollers being considerably nearer together. Between the upper and lower portions of the lowermost web, or apron, a trough is situated, which may be made of iron, and is to contain pitch and tar, or some similar compound, heated so as to keep it in a melted state. By means of a roller, the two contiguous portions of the wire web, that is, the upper portion of the lower, and the lower portion of the upper, are pressed down so as to dip into the melted compound. When these are made to revolve with the fleece between them, the latter is saturated with the compound; as it passes out of the trough the whole is pressed between metallic rollers, which condenses the felt and forces out all the superfluous matter. When delivered upon a table, it may be rolled up, or cut into sheets.

The foregoing is intended for the covering of ships, houses, &c.; but when saturated with size, or glue, mixed with clay, whiting, lime, or other suitable substance, it is to be used as a substitute for mill-board, pasteboard, floor cloth, and applied to other purposes.

The claim is to the method of subjecting such materials as are named, whilst between endless webs of wire, &c. to the action of the rollers, and of such liquids as may be desired.

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42. For an improved mode of *Spinning Rope Yarn*, and yarn for cords and lines; James Church, jr. Hartford, Hartford county, Connecticut, May 22.

Nine lines contain the specification, which consists of references to a very indifferent drawing. The object appears to be to enable the spinner in a rope walk to turn the band wheel which drives the spindles. He is to attach himself to a long band, and walking backwards give motion to a whirl upon a shaft, and this, by bevil gear, is to turn the band wheel.

We had much rather invent such a machine than work with it, as we do not admire that labour saving machinery which is to force a man to work harder than ever; we think the present contrivance well calculated to save one man by wearing out another.

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43. For an improvement in *Propelling Boats by Machinery*, by what is denominated the "Spiral Propeller;" Josiah Copley, Warrior-mark, Huntingdon county, Pennsylvania, May 22.

A shaft is to have affixed to it eight, or any other number of vanes, or fans, forming segments of spirals. These shafts are to be placed under water, parallel with the keel, and a rapid rotary motion given to them. It is proposed also to use them for driving machinery, by placing them in currents. The claim is to this kind of wheel, and its various applications.

We have had many opportunities of noticing this mode of pro-

pelling under various modifications, and have nothing new to offer upon a subject upon which all experience is at variance with the deductions of the present patentee. The specification before us is written wth considerable talent, it enters with much minuteness into the reasons upon which the conclusions of the patentee are founded, and, were the thing new, we should say that upon the face of the argument it merited a trial; it, however, has been tried with segments of nearly all possible sizes, and all possible angles, and that with uniform disappointment; that it will be again tried by the present patentee, with all the precautions which he has indicated, we have no doubt, as he is convinced in his own mind that he has discovered the causes of previous failures, and the modes of obviating them; still we are confirmed sceptics.

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44. For a new mode of *Cogging or Bushing Sheeves for Ships' Blocks*, and for other purposes; Rhodes Kingsbury, Bath, Lincoln county, Maine, May 22.

The bushes, or cogs of sheeves, are usually made of iron, with a triangular plate, or flanch, on one side, which is to be let into the sheeve, and rivetted through at each of the corners. The mode now patented is to make the bush, or cog, cylindrical on the outside, to cast or cut a screw upon it, and to screw it into the sheeve, where it will remain firmly fixed, without the letting in of a plate, the insertion of rivets, or any other fastening than the screw. The patentee states that the whole strength of the sheeve is thus preserved, the danger of becoming loose obviated, and three-fourths of the labour of fixing, saved.

The claim is to the application of a screw in the manner, and for the purposes, above designated.

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45. For an improvement in the machine for *Washing, Separating, and Saving Alluvial Gold;* T. W. A. Sumter, Poplar Grove, Iredell county, North Carolina, May 22.

This machinery consists of many parts, the principal of which are a *rocker* and a *trough*. The rocker is a box or spout, into which the earth is first thrown, where water is suffered to pass upon it, whilst a rocking motion is given to it; being a little inclined, the larger stones pass to its lower end, and are allowed to escape; it has a sieve in its bottom through which the sand, gold, &c. passes into the second vessel called a trough, which is a semi-cylinder, usually made of iron; it is supported upon spring poles, which serve to give it a vibratory motion.

The claims are to "the spring poles, and the manner of using them, and the *rocker* and its appendages applied for the purposes of washing and saving gold, in the manner above described."

How far this apparatus may be superior to what has been used elsewhere, we have not, at present, the means of determining. The drawings show the general structure of the machinery, but they are very indifferently executed, and leave much for the imagination.

A law was passed during the late session of congress to enable Vincent de Rivafinole to take out a patent for a machine for washing gold, which, in our judgment, will prove to be so far superior to every preceding instrument for the purpose of washing the alluvial deposites, as completely to supersede, or to leave those persons far in the rear who employ them. When the patent is completed, the particulars will be published in this Journal.

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46. For an improvement in the *Portable Furnace for Cooking*, and other purposes; William A. Haggerty, Thomas C. Lawrence, and Thomas Frazier, City of New York, May 22.

The tripartite *invention*, under the above title, is very briefly described, the whole specification being comprised in the following lines.

"The improvement claimed by the subscribers consists in the manner of lining the insides of kettles, (of cast or sheet iron, or other suitable material) with bricks of clay. Within the lining, and secured midway between the top and bottom of the furnace, is a grate, constructed of any suitable material, having an aperture underneath it, for the admission of air. On the upper surface of the furnace are placed any suitable number of knobs, or projections, for elevating the utensils, and furnishing the draft. The brick lining may be secured together by bands or hoops of iron, or other suitable material, and may be constructed of any shape required."

Short as is the foregoing specification, we think that it might have been given in fewer words than the inventors count in their names. "Line a furnace with brick," would, we think, have exhibited the whole body and soul of this "*new* and useful improvement," and as "brevity is the soul of wit," we should have found this in the specification at least. The inquiry into the respective contributions of these *joint inventors*, is one which might possibly involve much difficulty; we apprehend, however, that it would be found to amount to *ten dollars* each.

There is not any drawing accompanying this specification, although the law is imperative on this point, "and shall accompany the whole with drawings, and written references, whenever the nature of the case *admits* of drawings," are the words employed. A furnace, with an ash pit, grate, knobs, brick lining, &c. certainly *admits* of being drawn. Were any further evidence required that the thing might be drawn, it is supplied by the fact that a *model* has been deposited in the patent office.

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47. For an improvement in the art of *Stringing Piano Fortes*, denominated "Cross Stringing;" Alpheus Babcock, Philadelphia, Pennsylvania, May 22.

(See specification.)

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48. For a machine for *Thrashing Rice*, and all other kinds of small grain; Ephraim Sands, Cincinnati, Ohio, May 24.

When we take up a patent for a washing, or thrashing machine, notwithstanding continued disappointment, we still hope that genius may have contrived some new mode of effecting these objects; when the period arrives for the justification of these hopes, our delight will be expressed in no measured terms; that time, however, has not yet come: we have again a cylinder set with teeth, a hollow segment, likewise set with teeth, the usual feeding apron, and other old acquaintances, linked arm in arm, pretty much in the old fashion. After poring over some half dozen pages, we arrive at the information that "the above is a true specification of my improvements." No one thing is particularized, the whole congregation of parts, braces, whirls, cylinders, bands, cog wheels, and teeth, making part of the said "above."

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49. For an improvement in *Cloth and Hair Brushes;* Herrick Aiken, Dracut, Middlesex county, Massachusetts, May 24.

"The bristles, or hair, is twisted between wires, making a spiral brush, and trimmed to a suitable length. The spiral is then bent into any required shape, and the two ends of the wire are brought together, and put into a handle, and then secured." The foregoing will give a sufficient idea of the mode of making these brushes. The claim is to "the construction of the foregoing brushes, for clothes and hair. But I do not claim the principle of twisting hair or bristles between wires for making brushes, this having been before done."

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50. For an improvement in the *Saw Set;* Herrick Aiken, Dracut, Middlesex county, Massachusetts, May 24.

This instrument is to set saws by punching. The saw is laid upon a bed of steel, so that its teeth pass under an angular faced punch attached to a lever, and raised by a spiral spring. The punch is struck by a hammer. The saw rests upon the bed, sloping towards the back, so as to raise the teeth, and allow of their being set; this inclination of the bed is regulated by a screw.

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51. For an improvement in the *Machinery used for Spinning Cotton,* and other materials, consisting in the form of a *Flyer, or Traveller;* James Bogardus, City of New York, May 25.

This is another form of the ring groove spinner. There is a metal cap in the form of a truncated cone, surrounding each spindle, the opening being somewhat larger than the bobbin which is to run within it. The upper edge of the cone is surrounded by a rim somewhat like that produced on the upper edges of tin vessels, where the tin is turned over a wire; this rim is to retain the *Flyer* or *Traveller,* which consists of a piece of wire bent round so as to form a ring, excepting that the two ends do not touch each other. This ring is to be sprung over the rim, around which it will then play freely; this ring serves to retain the thread in spinning.

The patentee is very particular in giving directions for the exact form of the rim around which the traveller plays—states that travellers have been before used in various shapes, but never with complete success until the working parts received the form which he has given to them, and claims only "the form and application of the traveller as specified." The arrangement most nearly resembling the present, which we recollect to have seen, is that patented by Messrs. Addison and Stevens, of New York, in October last, and described at page 27 of our last volume.

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52. For a "*Labour Saving Machine;* Ichabod Lewis, Irville, Muskingam county, Ohio, May 25.

We are told in the specification that this machine "may be used in the art and manufacture of chairs, bedsteads, wheels, &c.; or in the manufacture of any articles where turning, boring, and sawing are required; and consists of an improved turning lathe, (in the principal wheel,) a machine for boring, and one for sawing, both of which latter are adapted to the lathe. And in the application of animal power, (of the dog kind) for the purpose of propelling the same. Whereby much manual labour is saved, and the manufacture of chairs, &c. &c. greatly facilitated."

The improvement on the lathe, is a hollow wheel for a dog to walk in to give motion to the machinery. The arms of the wheel are in the middle of a wide rim, like the band wheel of the yarn spinning machine, but 12 feet in diameter, and wide enough for the animal; "which leaves it open on each side, and allows us the advantage of tying the dog in the most proper place;" this, we are told, is the "*principal improvement.*"

The boring machine is pretty much like other boring machinery, with bits fitted in the lathe. The sawing part is a head which may be fixed on the lathe bench, and the saw, which is narrow, and fixed in a small frame, worked up and down by a crank on a whirl, worked by a drum and strap. These things are very imperfectly described, but they are not claimed. The whole claim is in the following words. "The improvement in the construction of the principal wheel, I claim as my invention, let it be applied to what purpose soever; or propelled by animal power of any kind."

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53. For a *Plough;* Samuel Nisbet, Toboyne, Perry county, Pennsylvania, May 25.

"The mould board and sheaths are made of cast iron, and cast together solid." We are then told how the tenons, stays, &c. are placed; that the *share* and *coulter* are of wrought iron, and of the common shape, and the same respecting the beam and handles; the claim is to "the construction of the mould board and sheath;" we do not understand what the construction is, the mode of connecting and supporting them being all that we find mentioned.

54. For a machine for *Sawing, Mortising, Tenoning, &c.;* Benjamin Overman, Greensborough, Guilford county, North Carolina, May 27.

This machine, and that of Mr. Lewis, No. 52, are both called "Mechanics' Assistants," a generic name for many patented machines intended to answer several different purposes.

We shall not pretend to describe this machine, as in its construction there is nothing peculiar, but merely the patentee's mode of arranging saws, chisels, wheels, &c. the whole of which appears to be claimed in the following terms. "Every improvement herein described, invented, made and used by me, Benjamin Overman."

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55. For an improvement in the *Churn;* Iram Brewster, Blenheim, Schoharie county, New York, May 28.

A vertical churn has two sets of dashers, turning horizontally, one within the other, in reverse directions. The shaft or collar of the outer dashers is perforated at the top, and the shaft of the inner ones passes through this perforation, and into a step at the bottom of the churn. A vertical toothed wheel turned by a crank, gives motion to pinions, or trundles, on each of the shafts. There is no claim, the whole arrangement being considered as new. A patent for a "Double Revolving Churn" was obtained by Messrs. Barney and Beach, of the State of New York, on the 5th of February last, but in this the churn itself revolved in one direction, and the shaft, carrying dashers, in an opposite direction. See vol. v. p. 292.

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56. For an improved *Machine for Lifting Ships out of the Water;* Thomas Evans, City of New York, May 28. Assigned to William Ballard, of the same place.

(See specification.)

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57. For a *Portable Furnace,* called the "Taylor's Furnace;" Asher W. Roberts, Hartford, Hartford county, Connecticut, May 28.

This "Taylor's Furnace," is very much like that described in No. 46, or very much like a common chaffing dish. It is merely a quadrangular box, of sheet or cast iron, with a grating in the middle to support the fuel, an ash pit below, and two or three bars above upon which to place the goose. The part containing the fuel is to be lined with soap stone. "The above is a true specification." We beg pardon, there is to be a handle to carry it about.

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58. For an improvement in *Glass-makers' Moulds;* Deming Jarves, Boston, Massachusetts, May 28.

The improvement claimed is the forming of a handle, or handles, or other similar projections, on glass cups, by pressure, at one ope-

ration, instead of attaching them to the cup after it has been blown, in the way heretofore practised.

The mould is to be made in the usual manner, of brass, or other suitable metal, excavations being provided for the formation of the handles. The plug, or piston, which is to form the inside of the cup, is made to fit exactly into a rim which forms the top of the mould, so that when it is pressed down none of the fluid glass which has been put into the mould can escape at top, but will, by the pressure, be forced into the cavities described.

The claim is to the forming the mould in the manner above indicated.

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59. For a compound of medicinal substances, called *The Chemical Catholicon,* or Smith's Sanative Medicine; Isaac W. Smith, M. D. Lockport, Niagara county, New York, May 28.

Without publishing the recipe, we will state that the ingredients which enter into its composition are sulphate of magnesia, [Epsom salts,] water, sulphuric acid, and muriate of mercury [corrosive sublimate.]

This "sanative medicine" is to "cure a variety of diseases, among which are *dysentory*, cholera morbus, *billious cholic*, habitual costiveness, vertigo, or dizziness of the head, and hypochondria."

We are told that "where the above is to be administered to persons afflicted with scrofulous affections, the solution of muriate of mercury is to be omitted." Query, will the doctor accompany his patent medicine bottles, carrying each kind with him, and examine all who are about to swallow his *sanative* draft, to see whether they are scrofulous or not? We trow not.

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60. For a *Washing Machine;* Enoch Walker, Woodbourne, Susquehanna county, Pennsylvania, May 29.

A fluted board is placed at the bottom of a water tight trough; a roller of a foot in diameter is placed above this, and between the roller and the board, pressure is made upon the clothes to be washed. The fluted board is to be raised at one end by means of a treadle, when the roller will pass over it by its gravity, and return when the board is lowered. A cistern to contain water, and a furnace to boil it, are placed at the end of the trough. Rollers, or wheels, are fixed under the machine to move it about from place to place. The roller which acts upon the clothes is to be made to run, occasionally, upon the lid of the trough, to serve as a mangle, and save ironing. This much is necessary to the understanding of the following claims.

"What I claim as my invention is the general construction of the machine as aforesaid, working the said fluted board or frame with rounds and roller by the same motion; the application of the treadle to washing machines; the wheels to move them about; the reservoir of heated water as aforesaid; the mangling with said roller, and pressure, instead of ironing the clothes, and the application of said

parts to every other purpose that will answer, not heretofore patented."

The drawing is without written references; the claim covers too much ground, as several of the parts mentioned have been before used, and if they had not, we should much doubt the validity of a patent for putting wheels, or castors, on to a machine for the purpose of moving it about.

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61. For a *Cooking Stove;* Lewis Peterson and Peter Peterson, Pittsburgh, Allegheny county, Pennsylvania, May 29.

The stove described is to be made of cast or sheet iron. In the front is the door of the oven, and that for the fire-place. The oven extends from top to bottom, and from back to front, with the exception of the spaces left for the flue. The fire-place is on one side of the oven, and the flame and heated air from it are to pass round the other three sides; the flame first rises, and passes over the oven, and under the top plate, then down between the oven and one of the end plates; then under the oven and fire-place, and up at the other end of the stove to the pipe, or chimney. The top plate has three perforations to receive cooking vessels.

There is no claim made, but the advantages presented by this stove are particularly detailed. The patentees say that "it is simple in the construction, and not liable to get out of order; consumes very little fuel; will take up but very little room; can be placed in any part of a room to suit convenience; a saving of labour to the cook; and will do away the necessity of the principal cooking utensils used in a kitchen, inasmuch as this stove comprises every convenience necessary for cooking. Baking, roasting, boiling, steaming, stewing, frying, and broiling, all can be done at the same time, without any inconvenience one to the other."

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62. For a *Washing Machine*, called the "Susquehanna Washing Machine;" Stephen Hinds, Montrose, Susquehanna county, Pennsylvania, May 29.

An oblong trough is made, as usual. The bottom of this trough rises in the middle, sloping off towards each end, like the ridge of a house, the angle, however, being very obtuse. Above this bottom is placed a frame, formed of slats, and extending the length of the box; which frame vibrates upon gudgeons, placed just above the ridge in the bottom. Two levers, one at each end of the box, and having their fulcra on one of its sides, are connected by ropes to the opposite ends of the vibrating frame. Above this frame there are two others, similarly formed, but not reaching to the middle of the trough; between these and the vibrating frame the clothes are to be placed, and operated upon by alternately pressing upon the levers, one hand being placed on each. Such is the "Susquehanna Washing Machine," which certainly has the merit of being differently arranged from most of its compeers; we, however, doubt its superiority, whatever it may possess of novelty.

63. For an improved method of *Applying Water to the Water Wheel,* known as the small flutter wheel; Edward Pritchard, Scriven county, Georgia, May 31.

The water is to be supplied to the common saw mill flutter wheel by two shoots instead of one; one of the shoots being placed above the other. "The water is made to act upon three floats at the same time; it also acts upon the outer extremities of the floats, or buckets, taking the advantage of the whole length of the lever; thereby doing away with the possibility of the *paradox* principle operating so as to retard the wheel, and using the whole head of the forebay."

"That of the above which I claim as my invention and improvement, is the applying of the two sheets of water to the water wheel, known as the *flutter wheel,* and used for saw mills."

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64. For an improvement in the *Steam Engine;* Charles Potts, Philadelphia, Pennsylvania, May 31.

The object proposed by the patentee, is to produce greater safety in the steam engine, by insuring a constant and uniform supply of water to the boiler.

A float is to be placed on the end of a lever, within the boiler, in the manner of the ordinary ball cock, the fulcrum of this lever is to pass through a stuffing box, to the outside of the boiler; this it may do below the seat of the safety valve, or in any other convenient position. The short end of this lever, or that without the boiler, is intended to be connected with a valve in the supply pipe, which is to regulate the quantity of water which passes into the boiler. This valve is placed between the condensing tub and the hot water pump; when the valve is completely open, it is to allow water enough to pass for a full supply of the boiler, at the time of the greatest evaporation. The short end of the lever to which the float is attached, the patentee calls an index, as the angle at which it stands indicates the position of the float, and consequently the height, or depression, of the water in the boiler. A rod connects the index with the supply valve; when the float is at the lowest allowable point, the valve is entirely open, and as the float rises, the valve closes, and the supply is diminished.

The claim is to the arrangement by which the motion of the float is made "to regulate the supply of water to the *hot water pump,* exactly in the ratio of the evaporation from the boiler; and also to its operation as an index, and tell-tale."

A paper, by Mr. Potts, giving an account of the foregoing, was inserted in the July number; our notice was written before the latter was received, and we have not thought it necessary to suppress, or alter it.

Specification of a patent for an improvement in the mode of laying the foundation of Marine Rail-ways under water. Granted to JAMES RONALDSON *and* JOHN LINDSAY NEILL, *of the City of Philadelphia, May* 22, 1830.

OUR said invention is particularly intended for marine rail-ways in places where, from the nature of the bottom of a river, or other water, on which it is to be established, piles cannot be securely driven, or where the expense of driving them, and of erecting the required structure upon them, would form a serious objection thereto. It is also applicable in all situations where the bottom is of a hard substance, and is equally efficacious with a foundation of piles, and can be carried into operation in many instances with much greater facility, and less expense.

A proper survey of the bottom upon which the rail-way is to be erected, must first be made, in order to ascertain the proper shape, or curvature, which should be given to the under part of the frame work, of which the foundation and rail-way, below the water, are to consist. This frame may be made and braced together in various ways, the sills being so formed as to adapt themselves to the bottom, and the upper part, or rails, having such an inclination as may be considered best for the intended purpose.

In forming the *Philadelphia Marine Rail-way*, the work was put together over the place where it was to be used, but it may be formed or framed elsewhere, and transferred to its place of destination. The framing was commenced by fixing a number of beams strong enough to sustain the intended superstructure, and in such relative positions as that a line crossing them would have the same curvature with the bottom of the river, which is to be the foundation. Upon these beams were laid three sets of sills parallel to each other, the centre sill being situated under the keel rail, and the two side ones under the bilge rails. The sills were united together by logs forming cross-ties; and into the upper sides of the sills were inserted posts to support the rails. These posts were tenoned into the sills sufficiently deep to admit of a trenail. The whole of the sills, rails, and posts, being strongly braced by timber framed into them diagonally and otherwise, to give them the required strength, iron bolts, dovels, and trenails, were also driven when they were deemed useful. The scarps of the rails, or wooden ways, were all doveled and bolted, and made to rest on the posts: the ways were likewise doveled to each cross-tie, besides bolting. The upper sides of the rails, or wooden ways, were made perfectly even, and the iron rails then securely bolted upon them.

The manner in which this framing was effected, is represented in the drawing, and also in a model deposited in the patent office; they are deposited in compliance with the law, which requires that drawings, with written references, be furnished; and they serve to ex-

hibit in a practical way, how the invention has been carried into effect.

The frame when completed is to be sunk into its place. Before this is done, the bottom upon which it is to stand, must, if covered by any loose substance, be scraped, so as to remove whatever might interfere with its adapting itself thereto. The mode which we adopted for sinking the frame, was, first to lay a floor upon the cross logs, or ties, and fasten plank to the sides. These planks were to keep in the stones, or material used to sink the frame. The supporting beams were then removed, and the whole frame let down by tackles that held it suspended when the cross bearings were taken out. To save the trouble and expense of procuring large stones, small ones were put into barrels and headed up, in order to retain them in the situations where they were required. The frame was thus sunk into its place, and loose stones, earth, and sand, thrown into, and around the whole.

We claim as our invention, the mode in which the above frame was put together; and we claim as new, and as our invention, this method of making the foundations, and the fixing of marine rail-ways under water, without the driving of piles, the making of coffer dams, the using of diving bells, or any similar structures, as usually employed for that purpose.

If the rail-way is intended for large vessels, the having *five* rail-ways, viz. one under the keel, one under each bilge, and one on each side for the support of the upper works of the vessel with shores, are all considered modifications of the principle herein described, and we accordingly claim this method also as our invention.

JAMES RONALDSON.
JOHN L. NEILL.

Specification of a patent for an improvement in the art of Stringing Piano Fortes, denominated by the patentee "Cross Stringing." Granted to ALPHEUS BABCOCK, *Philadelphia, Pennsylvania, May 24th,* 1830.

MY invention and improvement consist in having the two strings of each note formed of the same unbroken wire, which is secured at each end on the turning-pin-block, in the ordinary way, passes over the sounding board bridge, on which the two strings which it forms are kept asunder by a small pin, and is then twisted once or more; or the two strings are made to cross each other, so as in either case to form a loop, or eye. This loop, or eye, is then made to double round, or hook upon a pin on the pin-block, or on the metallic plate, which in some pianos advances from the pin-block, towards the sounding board bridge; or otherwise the loop, or eye, is passed over and fixed on a hook made in the end of a rod, or stout heavy wire of metal, which is fastened at the other end into the pin-block, or into the metallic plate, (above spoken of,) and projects to within a

short distance of the sounding board bridge; so that the strings have the same line of direction from the pin-block to the turning pins.

(*Note.* By inserting two pins instead of one on the bridge, the strings may be arranged without crossing, or twisting them; but, in such case, the strings must change their line of direction at the bridge, and a lateral strain is of course produced, unfavourable to the durability of the instrument.)

The mode of stringing described in this specification is applicable to all instruments of two or four strings, whether made with metallic or wooden frames. The modification of it which I prefer, is that which includes the use of the metallic rod between the strings and the pin-block.

The advantages gained by this arrangement are the following.

1st. The strings are less liable to get out of tune; inasmuch as the part of them beyond the bridge is by this mode of stringing greatly shortened. For the same reason the strings are more easily tuned; the friction of the string on the bridge, in the process of tuning an ordinary piano operating always to prevent an equal degree of tension on the two sides of the bridge, and in fact often causing the bridge of the sounding board to support much of the strain which should properly be borne by the pin-block only.

2nd. The sounding board bridge is relieved from the lateral strain which in the common piano is occasioned by the strings changing their line of direction, after crossing it; as well as from the strain alluded to in the foregoing paragraph; thus increasing the durability of the instrument.

3d. The false tones, to which all ordinary pianos are more or less subject, produced by the vibration of the strings between the bridge of the sounding board, and the pin-block, are obviously prevented by this improvement, and the tone of the vibrating part of the string is left clear and brilliant.

ALPHEUS BABCOCK.

Specification of a patent for a machine for Lifting Ships or Vessels out of the Water. Granted to WILLIAM BALLARD, *of New York, as assignee of the inventor,* THOMAS EVANS, *of the City of New York, May* 28, 1830.

THE invention above mentioned consists in the application or substitution of cylinders with floating pistons in them in place of screws, or other machinery, in the vertical lift docks now in use. These cylinders with their pistons are constructed in precisely the same manner as what is known and called Bramah's hydrostatic, or water press, and are applied to the lifting of ships in the following manner, to wit; such a number of piles are driven in the river, as to form two piers at such distance apart as to allow a ship to be floated in between them; those piles which form the inner row of those piers, are driven at regular distances asunder, and are firmly secured together by large pieces of timber called plate pieces, running the

whole length of the dock, on each side, level, or even with the surface, or decks of the piers. Between these piles, and from said plates, are suspended a row of cast iron cylinders at equal distances apart, and directly opposite each other, on either side of the dock. Each of these cylinders is furnished with a solid iron piston, sliding through a stuffing box in the head of the cylinder; each piston has a cross head, fitted on its upper end, reaching to square posts framed into the plate, half way between the cylinders. These posts form guides for the cross heads, causing them and the piston to which they are connected, to move perpendicularly to the cylinders. From the cross heads iron bars are suspended on either side of each piston, reaching down through the plates to the trussed beams, or girders, which form the cradle for supporting the ship. These bars pass through the ends of the beams aforesaid, and are strongly secured to them by iron keys passed through the bars on the under side of the beams. These beams are made of great strength by a peculiar method of trussing them; they reach the whole width of the dock, two to each pair of cylinders forming a section; a number of sections forming the cradle; the length, breadth and strength of which will depend on the size of the ship to be lifted. Each section moves independent of the rest, and can be raised or lowered at pleasure. The cylinders are connected together on each side of the dock by a pipe running the whole length thereof. In these pipes, between each cylinder, there is a stop cock, shutting off the communication between them when necessary. One or more pumps are attached to these pipes for the purpose of forcing water into the cylinders for raising the ship. Other stop cocks are provided for letting the water out of the cylinders when the ship is to be lowered.

Operation.—The water being let out of the cylinders by turning the cocks aforesaid, the pistons by their weight settle down in the cylinders, carrying the cradle along with them; and when the pistons are wholly within, the cradle is sunk low enough beneath the surface of the water to allow the ship to be floated in between the piers, and over the cradle; she being moored in the centre between said piers, her keel is directly over the keel blocks. The pumps being now set at work, the cradle is raised till the sections have all found their bearings. The bilge wedges are now hove up to steady the ship in her position. She is now lifted some distance further, when being safely shored, she is by the continued action of the pumps safely and expeditiously lifted out of the water.

The lowering of the ship is a work of great simplicity; a number of escape cocks on each side of the dock are opened and she descends by her own weight with a steady, constant motion, till she finds her bearing in the water.

Now I wish to be understood that what I claim as new and my invention, is the application of what is called the hydrostatic principle of forcing water into cylinders, after the manner of what is known as Bramah's press; the raising of the pistons by the injection of water into the cylinders in which they are inserted, being applied to lifting the ship in the manner described above. And further, be it

known that I do not confine myself to the particular manner of application as described above; that only appearing the most convenient at present. T. EVANS.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks upon Mr. CHARLES P. SAKMEISTER'S *patent for improvements on the Piano Forte.*

TO THE EDITOR.

SIR,—As you appear to desire to elicit truth in your examination of patented inventions I am induced to offer a few remarks upon one issued on the 14th of May last, to Mr. C. P. Sakmeister, of New York, for improvements in piano fortes. Having had an opportunity of examining the specification and drawings, explaining the so called improvements, and claiming some knowledge upon the points to which they relate, you, perhaps, may not deem my remarks impertinent.

Mr. S. claims, in his specification, three improvements, the first the introduction of a lever check to prevent the reverberation of the hammer. Secondly, a lever upon which the front catch is placed, and the manner in which it is made to act upon the hammer. Thirdly, the shape of the hammer, of the inverted action, (as practised by the Germans.)

With respect to the first, I witnessed the same thing in the manufactory of Messrs. Loud & Brothers, of this city, three or four years since; the action then made by them was so similar to that described by Mr. S. that had it been made since his patent was obtained, any one upon examination would at once declare that his plans had been copied from it; they are, in fact, alike in the lever and its attachments, and in the mode of its operation in every important particular, (I speak of its application to the English action.) The front catch is merely an inversion of the other, its principle being the same.

I am convinced, however, that in practice, whatever advantages it might have offered were more than counterbalanced by its defects, as the Messrs. Loud do not continue to use it. Its complexity probably subjected it to frequent derangement. The simple check attached to the key, is, upon the whole, certainly preferable, as by the very easy contrivance of taking off the top part of the action, the key can be taken out.

With respect to the shape of the hammer, one exactly similar to it was formerly used by Mr. Albrecht, of this city, and it is believed that it had been previously employed by other makers.

These remarks, sir, are not invidiously made; the writer would hail with pleasure any real improvement in his business, by whomsoever introduced. The gentleman who has taken the patent, may, like many others, have stumbled upon something which he may have

supposed to be new, but which appears fairly to belong to your class of *modern antiques.* A MANUFACTURER.

Philadelphia, August 10th, 1830.

Notice respecting the Mortising Machines patented by Mr. JOHN M'CLINTIC, *of Chambersburg, Pennsylvania, in* 1827, *and by* Mr. ABNER FOSTER, *of Phillipston, Massachusetts, in* 1830. *Extracted from a letter to the Editor from the former gentleman.*

SIR,—In examining the number of your very valuable Journal for the present month, I find that mention is made of an improvement in the mode of mortising, in various kinds of joiner's work, for which a patent was obtained by Mr. Abner Foster, in April last. You remark that the machine is very clearly described, and very perfectly represented in the drawing, and that in its general structure it resembles the machine patented by me in October, 1827. You very correctly state that in mine the chisels are brought down and raised by means of a lever moved by hand. In Mr. Foster's *improvement* it appears that the levers used are called *treadles,* as they are operated upon by the foot, and that the chisels are elevated by spring poles. The only parts claimed, are, you say, "the springs and the treadles, and their application to the purpose of mortising."

Upon examining my specification, it will be seen that even in these particulars Mr. Foster has been anticipated by me. The following words will be found in it: "the gate, or part which holds the chisels, may be worked by *treadle* and *spring,* to raise the gate."

Independently, therefore, of the general structure of the machine being similar to mine, it will be at once evident that in the points specifically claimed by Mr. Foster, the ground had been clearly and distinctly pre-occupied by me.

To one who has manifested so much zeal for the diffusion of correct information on the useful arts, I need make no apology for the trouble I now give.

Yours, &c.

JOHN M'CLINTIC.

Chambersburg, Pennsylvania, July 31, 1830.

ENGLISH PATENTS.

To WILLIAM GODFREY KNELLER, *Chemist, for certain improvements in Evaporating Sugar, which improvements are also applicable to other purposes.* Dated May 27, 1829.

I, the said William Godfrey Kneller, do hereby declare that my invention consists in a method or process, and certain apparatus as hereinafter described, by which I am enabled to evaporate liquids and solutions at a low temperature, and thereby to avoid the injury to which certain substances which require a nice and delicate appli-

cation of heat, such as sugar, for instance, are liable to, by being exposed to too high a temperature. And I do further declare that my said invention and improvements consist in forcing, by means of bellows, or any other blowing apparatus, atmospheric or any other air, either in a hot or cold state, through the liquid or solution subjected to evaporation; and this I do by means of pipes, whose extremities reach nearly (or within such distance as may be found most suitable under peculiar circumstances,) to the upper or interior area of the bottom of the pan or boiler containing such liquid or solution, the other extremities of such pipes being connected with larger pipes which communicate with the bellows or other blowing apparatus, which forces the air into them. The pan or boiler may be of any shape or dimensions, but I prefer it with a flat level bottom, and I introduce the liquid or solution to the depth of from about four to six inches. The heat may be applied to the lower or exterior area of the bottom of such pan or boiler by naked fire, steam, or hot air, in the usual manner, and by means well understood; the air then forced into the heated liquid or solution keeps it in a constant agitation, abstracts its heat, and carries off the steam or vapour which is to be expelled. By raising the degree of heat under the pan or boiler, and increasing the quantity and velocity of the air injected into the liquid or solution, or on the contrary, by lowering the heat and moderating the injection of air, the evaporation is accelerated or retarded at the pleasure of the operator, according to the nature of the substances or the effect desired.

And I do further declare that in applying this my said invention and improvements to the evaporation of cane juice or sirop for making refined sugar, I can bring it to the proof or crystallizing point by keeping the temperature of such sirop, or cane juice, between one hundred and forty, and one hundred and seventy degrees of Fahrenheit's thermometer, although I prefer to keep it between one hundred and sixty, and one hundred and seventy degrees. By this simple and cheap apparatus I obtain a great quantity of large and shining crystals, which hitherto were attainable only by evaporating *in vacuo*, a very troublesome and expensive process, while other methods, by exposing the sugar to a high temperature, impair the quantity, size, and brilliancy of the crystals, and form a great quantity of molasses or treacle.

And I further declare that these my invention and improvements can be applied to the evaporation of other liquids and solutions, as well as sirops and cane juice, or sugar, by varying the apparatus and the degree of temperature according to their nature and the will of the operator.

And I further declare that these my invention and improvements can also be applied to distilling or rectifying spirits, provided that a vent be given to the air arising with the spirit after the latter shall be condensed.

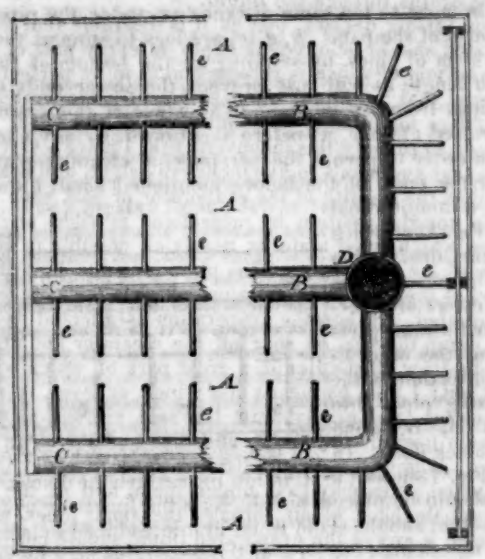
And I further declare, that in order more quickly to remove the steam or vapour from the surface of the liquid or solution, and thereby to favour the evaporation, I sometimes, and particularly when I

use hot air for heating the pan or boiler, conduct the hot air, after it has given out part of the heat to the bottom of the boiler, to the surface of the liquor or solution, but I do not consider this contrivance necessary in any, nor adviseable in all cases. It is hardly necessary to observe, that the evaporating power is augmented by increasing the diameter of the pipes, and the quantity of air propelled by the blowing apparatus through the liquid.

And I do further declare, that as it is desirable that the liquid to be evaporated should be of equal depth in every part of the evaporator, the bottom of which is recommended to be perfectly level; it will be found that the liquid when sufficiently evaporated and concentrated, does not readily flow out through the spout opened for the purpose; to remedy this inconvenience, I place a vertical sliding plate from four and a half to five inches in height, and somewhat less in length than the breadth of the evaporator or pan, such plate being kept in its upright position by projections at right angles with its lower edge, which must slide as nearly as possible in contact with the bottom of the same pan. This plate is in the first instance put at that end of the pan, or evaporator, which is opposite to where the spout is situated. When the evaporation is effected to a sufficient degree, I damp the fire, or shut off the steam or hot air, and open the spout to draw off the liquid, a great part of which will immediately flow out; I then by means of a winch, or lever, raise the pipes about six inches, and gently draw the said vertical plate by a thin wire or chain towards the spout, and thus quickly clean the bottom of the pan. It is necessary to raise the pipes in order that the before mentioned plate may pass under them, and at the same time not interrupt the blast of air through the small pipes, which might be obstructed if any of the evaporated liquid should congeal or crystallize in them by cooling. For effecting these objects the main pipe arising from the bellows or blowing apparatus, is inserted into the main pipe in the evaporator, in an air tight manner, but with a joint or flexible tube sufficiently long to allow the system of blowing pipes to slide upwards for about six inches. The form and construction of the apparatus which I use to produce the above effect, may be varied according to circumstances, and the form and position of the pan or evaporating vessel to which it is to be applied. But two things are essential in its construction, the first of which is, that however numerous the blowing pipes may be, that their lower orifices should be distributed as evenly and equally over the whole surface of the bottom of the pan as possible, and secondly, that a stream of air should issue from the lower end of every one of them at the same time. To insure this latter object it is immaterial whether the bottom of the pan or boiler be perfectly level, but it is quite necessary that all the lower ends of the blowing tubes should be on a level and parallel to the surface of the fluid to be evaporated, in order that there may not be a higher column of fluid in one tube than in another. The mode of construction necessary to produce these objects may be various, but in order the more distinctly to explain my meaning and my mode of operating, I hereunto subjoin a drawing of the apparatus

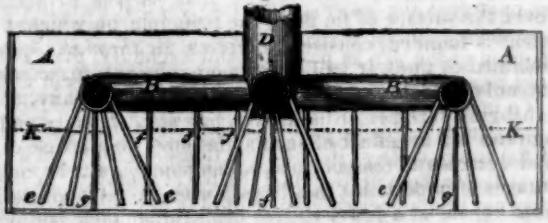
which I have used, and find to answer the purpose, and in which A, A, A, A, Fig. 1,* is a plan or bird's eye view of an oblong pan or boiler, B, B, B the tinned copper, or other large air pipes, which are closed at their end, C, C, C, but open into each other, and likewise into the still larger perpendicular pipe D, from which the air is

Fig. 1.



supplied by communicating as aforesaid, to bellows or other blowing machinery; *e*, *e*, *e*, *e*, &c. are the small lateral pipes which communicate with the large air pipes, and proceed downwards through the fluid to be evaporated, to very near the bottom of the pan. The lower ends, *e*, *e*, &c. of these pipes are all very nearly equi-distant from each other, to produce the equal distribution of air before mentioned. Fig. 2, is a transverse section of the pan, A, A, A, A, Fig. 1,

Fig. 2.



* In the original drawing the boiler is represented as extending to about three times the length seen in Figs. 1 and 3, the middle being omitted, as it is merely a repetition of parts similar to those shown.

showing the great air pipe D, the cross pipe and its continuations B, B, B, in section, and the small descending pipes *e*, *e*, *e*, *e*, &c. as shown in the last figure, likewise the pipes *f*, *f*, *f*, *f*, which likewise descend from the pipes B, B, but in a more nearly vertical direction, which prevents their being seen in the view, Fig. 1, but by means of which, the distances of the lower ends of these blowing tubes are brought to the same distance as under the pipes B, B, as in other parts of the pan. *g*, *g*, *g*, are legs to support the above described system of pipes, by standing on the bottom of the pan, and are of such length as will just prevent the lower ends of the said blowing pipes from touching it. The whole of this system of pipes is to be raised at once, as before mentioned, by any adequate machinery, in order to permit the scraping or cleaning plate, *h*, *h*, to pass under the ends of the before mentioned small blowing pipes.

Fig. 3.

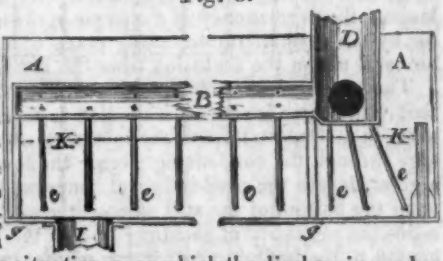


Fig. 3 is a longitudinal section of Fig. 1, of which a particular description will be unnecessary, as the same letters of reference denote the same parts in this and the other figures, the insertions of the small blowing pipes into the pipes B, B, being shown by black dots. In all these, Fig. 1 shows the situation near which the discharging valve or orifice should be placed, and K, K, is the line near which the surface of the fluid should stand when first introduced to be evaporated. As before mentioned, the form of this apparatus may be varied, provided its essential properties of the air blowing through all the descending tubes, and this being so disposed as to produce greatly divided and equally distributed currents of air over the whole bottom of the vessel at once, are maintained, because my invention consists in producing rapid evaporation at lower temperatures than usual, by the means hereinbefore described.

OBS.—It is well known that a current of air promotes evaporation, and is in many instances employed for that purpose by being made to pass over the surface of liquids; the principle on which the foregoing patent is founded, consists in forcing air *through* liquids, and we are inclined to think it will prove more efficient, inasmuch as the air is not only brought into intimate contact with many, and constantly changing surfaces of the liquid, but also strongly and incessantly agitates it; the effect of such agitation is an increase of evaporation and decrease of temperature, which points are to be considered as advantages of importance in all cases where liquids are to be converted into vapour at a lower degree of heat than their boiling point, under the common pressure of the atmosphere.

It has been stated to us, that by Mr. Kneller's process the evaporation of water is more rapid at 180° of Fahrenheit, than by boiling

at 212°, and is consequently attended with a considerable saving of fuel.

The same object has been attained *in vacuo*, but the present apparatus, we readily admit, appears to have the advantage over that method, both in simplicity and cheapness, from its requiring fewer and less expensive vessels; in other respects the results must be similar, as the high temperature is avoided which injures the products by acting on the substances exposed to it, and favouring new combinations.

The refined sugar made by evaporating on this plan, has been represented to us as being equal, and in some respects superior to that evaporated *in vacuo*, as having the property of not being effected by a damp atmosphere; the former circumstance is so far in accordance with the theory, that a high temperature prevents the formation of large and shining crystals, and converts sugar into treacle or molasses; the permanency of the sugar in the open air may be accounted for by the crystallization taking place under an abundant supply of air, and not in the seclusion from the atmosphere.

The patentee in a communication he has made to us, observes, that "the same invention if applied to distilling ardent spirits, raises them in a *clean* state, and the injection of air accelerates their passage through the condensing worm; the low temperature prevents in a great degree the production of empyreuma; the air forced down upon the bottom of the still keeps it cool, and the agitation supersedes the necessity of *rousing;* and as the wash is not suffered to be heated to the boiling point, it can never rise into the *head* and cause the spirit to *run foul.* The sugar house of Messrs. Widder & Co. Gravel Lane, Houndsditch, is fitted up and worked with this apparatus." [*Rep. Pat. Inven.*

To JOSIAS LAMBERT, *Esq. for an improvement in the process of making Iron applicable at the smelting of the Ore, and at various subsequent stages of the process up to the completion of the rods or bars, and a new process for the improving of the quality of inferior Iron.* Dated February 4, 1830.

THE improvement in the process of making iron applicable at the smelting of the ore, and at various subsequent stages of the process up to the completion of the rods or bars, consists, in the application of salt, potash, and lime, mixed or combined together to the iron ore, or iron in the blast furnace, the refinery furnace, the puddling furnace, the balling or reheating furnace, or in any other process to which the iron in its manufacture is subjected when considerable heat is applied; and it likewise consists, in the application of salt, saltpetre, and lime, mixed or combined together to the iron in the puddling furnace, whether the same iron shall have been subjected to the application of salt, potash, and lime, in any of the previous operations of the manufacture or not.

The proportions in which I recommend the mixture or combination of salt, potash, and lime, to be formed, are two parts of salt, one part of potash, and two parts of lime; but should the proportions in some degree differ from those best adapted to the purpose, the useless portions will be dissipated in the process of the manufacture. The mixture or combination employed during the process in the blast furnace should be applied at the time of smelting the materials, which are to produce the iron, at the rate of about twenty-five pounds to the ton of iron, and may be introduced in proportionate quantities at the tunnel head of the blast furnace, either at intervals, or with every charge of the materials which are to produce the iron. If not used in the process of smelting, it may be applied at intervals to the metal during the operation in every charge of the refinery furnace, or in the puddling furnace, or in any other process to which the iron in its manufacture may be subjected when considerable heat is applied. A proper proportion to be used in the refinery furnace may be at the rate of twenty pounds to the ton of iron, and in the puddling furnace about eighteen pounds to the ton of iron; but in the balling or reheating furnace, and other processes, the quantity to be applied must depend upon the quality, form, and substance of the iron, taking care that it be sprinkled over and amongst, or brought in contact with the iron; the quantity to be employed will vary from about eighteen to thirty pounds per ton of iron.

The proportions in which I recommend the salt, saltpetre, and lime, to be mixed or combined, are two parts of salt, one and a half parts of saltpetre, and two parts of lime; should these proportions differ in some degree from those best adapted to the purpose, the useless portions will be dissipated during the process of the manufacture.

This mixture or combination of salt, saltpetre, and lime, should be applied to the iron in the puddling furnace whilst the metal or pig iron is in a state of fusion, and may be mixed with it at intervals at the rate of about twenty pounds to the ton of iron.

The quantities to be applied of either of the above mixtures will differ in some degree according to the quality of the materials or the iron; but the proportions above mentioned are those proper on the average.

The process for the improving of the quality of inferior iron, consists in the application of either of the same mixtures in similar proportions to such iron when subjected to considerable heat: for this purpose they may be applied to the iron, and the iron melted in combination with them, or they may be applied to the iron in the puddling furnace in such quantities as may be best adapted to improving the quality of the iron according to its properties more or less exhibited, of being what is termed red-short, or cold-short, (that is to say,) the application of the mixture of salt, potash, and lime, is best adapted to the iron which is termed red-short, and the mixture of salt, saltpetre, and lime, is best adapted to the iron termed cold-short; the quantity of the mixtures to be employed in either case, will vary from about eighteen to thirty pounds per ton of iron, according to the degree of inferiority of the iron; or the mixtures may be applied to the

iron in any reheating or other furnace, and the metal subjected to a red heat for a time proportioned to the quality, form, and substance of the iron, care being taken that the mixtures be applied in contact with the heated metal; and for this purpose, if the iron be in the form of tubes, such as gun barrels, the mixtures may be introduced into the tubes.

Observations by the Patentee.—The effect of this application in the blast furnace, is, to create a more perfect fusion of the earthy materials, and their separation from the iron in a more powerful degree than can be effected by any of the ordinary methods of burthening a furnace; the pig produced under this operation is considerably more pure than any obtained in the common smelting process. A similar effect is produced in the refinery furnace, the iron runs hotter, the cinders contain less of the metal, and their proportions of earthy materials are increased, whilst a saving in yield accrues to an important amount. In the puddling furnace the application of the mixture of salt, saltpetre, and lime, is of the most powerful efficacy in causing the decomposition of the carbon and the acid combinations that have resisted the operation of the refinery. Nearly all the bar iron produced from coke made pigs contains more or less of earthy bases; certain proportions of these influence the quality materially by contributing to the red and cold-short properties; the earths are brought into a fusible state and completely vitrified by the alkali and the lime, and being separated from the iron leave it pure and free from defect. It remains only to be added, that the practice coincides with the theory of this process, and the fact has been proved by an infinity of experiments upon the worst description of iron, which has corresponded with the anticipated effect, both in its mechanical and chemical properties. [*Ib.*

To Joseph Marie Ursule la Rigaudelle du Buisson, *Merchant, for a new method of extracting, for the purpose of Dying the Colour from Dye Woods and other substances used by Dyers.* Dated February 12, 1830.

This process is performed by means of steam caused to pass through the substance to be operated upon, which condenses in its passage and extracts the colour; it is then evaporated to any consistency at the pleasure of the operator.

The apparatus employed by the patentee is composed of a steam box lined with lead, and covered by a shallow metal pan; a pipe proceeding from a boiler, communicates at one end of the box, and filling it with steam, heats the pan and its contents in the course of the process; from the opposite end of the box a second pipe proceeds upwards through the bottom of a wooden chamber, (that is lined with glass or glazed earthenware) to the distance of about one foot from the top, the lid of this chamber is constructed so as to open, and when closed, to remain steam tight; a quantity of chips or saw dust of the

dye wood being put in at the top, it falls on a false bottom of perforated tin, and the steam being admitted into the steam box, will find its way through the pipe and fill the space that is left in the chamber; in passing downwards through the dye wood it condenses, and dripping on the real bottom of the chamber, which is placed on an inclined plane, is conveyed from thence by a small pipe to the shallow pan described; in this situation it is observed, the liquid thus produced may be evaporated by means of the steam that is below it,—even to powder if it be necessary. When the liquid flowing from the chamber becomes colourless, the whole of the dying properties of the wood has been extracted; the chips, which will be found bleached, may then be removed and a fresh portion operated upon.

In a clause at the conclusion of the specification, the patentee observes that, if the substance employed be of a resinous nature, the vapour of spirits of wine must be used instead of the steam of water.

[*Ib.*

To George Pocock, *Gentleman, for improvements in making and constructing Globes for astronomical, geographical, or other purposes.* Dated February 4, 1830.

Mr. Pocock commences his specification, by detailing the disadvantages arising from the importability of globes of the usual construction, and in continuation states, that to obviate such inconveniences is a principal point of his invention. He, therefore, proposes to form them of paper, well pasted together at the edges, and with an aperture at the south pole, by which they can be inflated at pleasure: another method he adopts, is to construct a globular frame of thin cane, in the same way as applied to umbrellas; in both instances, however, he directs a wire or other support to be inserted through the orifice at the south pole, which, by means of a button at its upper end is attached in a corresponding eyelet hole in the interior of the globe at the north pole; to the latter part on the outside, are affixed three pieces of tape, of about a foot in length, with an ivory knob, to serve as a handle, attached to their centres; these tapes strengthen the globe, and a cane hoop for a similar purpose is attached to the orifice before mentioned, by means of a strip of linen pasted firmly over it and the edges of the globe.

A great portion of the specification is taken up by the description of a sort of air pump for inflating the globe; which operation, the patentee, however, states, may be performed by holding the cane hoop at the orifice firmly in the hand, and drawing it suddenly through the air; it is then to be placed on the carpet or floor of a room, and being raised about a foot from the ground and lowered alternately, it will be thoroughly distended.

He next describes a flexible scale for working problems, which he forms of tape half the circumference of the globe in length; it is divided into two equal parts, and ninety degrees north and south from the equator are marked on the left hand side; this serves for the

brazen meridian of ordinary globes. On the right hand side are marked one hundred and eighty degrees continuously, and under each, the corresponding number of miles; this is intended as a substitute for the quadrant of altitude, and much despatch, it is stated, will be gained by it in working problems. On the opposite side of the tape is an analemma done in the same way as the scale.

A modification of these globes is also described, formed with a vane at its upper extremity; a lamp being placed in the interior, will, on the globes being suspended by the rarifying of the air, cause it to revolve, and present an amusing and instructive object for young persons. The paper recommended by the patentee for the construction of these globes is that made of new Irish linen; its strength being an important object. [*Ib.*

To JOHN GRAY, *Gentleman, for a new and improved method of preparing and putting on Copper Sheathing for Shipping.* Dated February 4, 1830.

THE object the present patentee has had in view, is the preventing any projection or indentation in the sheathing of ships when fixed on them; and he causes a perfectly regular and smooth surface to be obtained, by forcibly forming indentations in the sheets, which will present corresponding projections on the opposite side, the heads of the nails being countersunk in the former, whilst the latter are admitted into the wood; this, it is stated, will also give additional security to the means of fastening the sheets.

The tool employed for forming these countersunk perforations, consists of a screw working in a socket formed in the centre of a metal frame or bridge, that is firmly screwed to a bench or table. The lower extremity of the screw is a conical punch, which, when screwed down, fits into a corresponding piece of metal having a small perforation formed through it, for the passage of the particles of copper that are punched out of the sheet. This latter after having been laminated and dressed, is placed below the punch, and the screw being turned by a lever passing through its top, the conical form of the punch will create a countersunk projection in the sheet of copper, into which the heads of the nails are to be made to fit, so as to present an even surface. The legs of the bridge above mentioned, are directed to be made far enough apart to admit of the passage of the sheets below it, and they thus serve as a guide for making the perforations in a right line. In affixing the sheets to the bottoms of vessels, they are to be caused to extend half way over each other alternately, in the usual manner.

A modification of this instrument is described in the specification, which the workman can employ in his hands without the necessity of its being attached to a bench; in this case, the screw socket and the indented metal for the reception of the punch are formed in one piece, from which also projects a handle: two small plugs that are raised and lowered by placing the thumb on a spring near the handle,

and are fixed at proper distances from the screw, serve as guides, by falling into the perforation made in a sheet, and thus retaining it in its proper position when drawn along to repeat the stroke of the punch. [*Ib.*

FRENCH PATENTS.

Patent for fifteen years, for methods of manufacturing Wire for Piano Fortes and other musical instruments. Granted to IGNACE PLEYEL, *of Paris.*

THE white wires are made from soft and very ductile iron wire. The French iron wires best suited for this purpose, are the kinds known under the name of *fer de roche.* We employ in this manufacture, only iron which has already been reduced into wire, at least to the dimension of two-thirds of a line in diameter. These wires owe their quality to the manner of tempering or annealing the iron wire, and of passing it through the draw-plates.

To anneal the wire, a fire place is built of bricks and mortar, of a cylindrical form, having its exterior and interior edges furnished with an iron hoop, beneath a large chimney. The dimensions of this fire place or furnace are proportioned to the quantity of iron wire intended to be annealed at one time, which is placed in it, upon an iron grate. This grate is placed so high, as not to allow the fire to touch the wire. The furnace is covered with a sheet iron cover, in which there is a hole, for allowing the smoke to escape. The iron wire is placed in coils upon the grate, till it reaches to about four inches of the top, the cover is put on, and a fire lighted with white wood only. The heat is kept up till the wire has acquired a pale red colour, and not more. That the fire may be distributed equally throughout, the cover should be frequently turned, because the hole in it would attract the heat, and, without that precaution, one side would be heated more than another. This method of annealing suits only iron wire of the size of one-third of a line in diameter: to draw it finer, the following process should be employed.

In the furnace already mentioned, at a certain height above the grate, are supports, on which another similar grate is placed. A strong plate of sheet iron is laid on each of these grates; the dimensions of the plates, allowing an inch all round for the passage of the ascending smoke, to allow the cinders to fall from the top, and to promote an equal communication of heat. The iron wire ought to be wound into a narrower space than the width of the plates of sheet iron, and placed on the lower plate in such quantity, as to reach the upper one. The lower fire place is filled with fuel, and the same combustible is placed on the upper plate, both fires are then lighted, the cover is put on, and frequently turned during the process.

In a furnace capable of holding fifty pounds of iron wire, the fire is kept up for four or five hours, the length of time depending, however, on the situation of the furnace and consumption of fuel.

The first process of annealing is commonly done twice on the same iron wire: the second is done after that wire has been drawn three or four times through the draw-plate, for reducing its diameter. The second process is employed but once.

Tools used in this manufacture.

These tools consist of, 1st, a wooden work bench four or five feet long, and three wide. 2nd, a plank, three feet long, one foot wide, and three inches thick, which is fixed to one of the edges of the bench by two pins. Above this plank two little barrels of wood are raised, ten inches in length and six in diameter, each having its axis placed in the direction of the width of the plank, and received in two brass supports, fixed firmly against the lateral sides of the said plank. The axis of each roller is furnished with a handle, for moving it. At the middle of the plank there is raised, to the height of the centre of the axis of the barrels, a piece of wood of the whole width of the plank, in which is a groove, four or five lines deep. At each extremity of this piece of wood two wooden uprights are framed, supporting a cross piece, in which is a second groove, corresponding to the first. A draw plate is adjusted, so as to slide easily between these two grooves. At each end of the same plank, and by the side of the draw-plate, a small piece of hard wood is placed, on which the ends of the iron wire are filed before passing them through the plates.

A sort of reel, nearly like those used for thread, excepting that it is conical, serves to receive the rings of iron wire intended to be drawn. The bench, serving as a foot for this reel, is raised to the height of the barrels.

On a small wooden upright, placed in a mortise made in the plank, between the barrel and the draw-plate, a little box is fixed, containing grease, composed of lard and tallow. There is a hole through this box, to allow the iron wire to pass through it, and become smeared with the grease.

To beat up the draw-plate when the holes are too much worn, and to pierce it, we employ a block of wood, similar to those commonly intended for receiving small anvils, and on which a mortise is made sufficiently deep.

A small file is used to reduce the end of the wire, when beginning to draw it; a pair of flat pincers for drawing it, when introduced into the holes of the draw-plate; a common hammer, and an iron gauge for measuring the sizes of wire; lastly, a draw-plate is the most essential tool that we must have for this work. The material of which this tool is composed, and the way in which it is pierced, contribute very much to the quality of the wires.

A draw-plate, to be a good one, must be made of a substance, neither too hard, nor too soft: all those which are steeled are good for nothing; and pure iron is equally unsuitable. The best material for making them, is a mixture of the best bar iron, and cast iron. These plates should be pierced, so that every hole goes on diminishing, in diameter, underneath: these holes are commenced with conical steel punches, which are struck; the draw-plate is then put to heat

in a fire of only wood, and the operation of piercing it, is afterwards completed, when cold, with steel punches. It is necessary to have punches corresponding to all the diameters of wires required to be drawn.

Manner of working.

When all the tools are ready, as above mentioned, and the iron wire is also prepared, it is put upon the reel which is placed at the end of the bench. The end of the wire is then filed, pushed through the grease box, and into the hole of the draw-plate corresponding to its size, and is drawn by hand with the pincers till it can be attached to the barrel, where it is fastened by points which are fixed for that purpose on the barrel: the barrel is then turned gently by means of its handle.

For the first course, it is necessary that the barrel which does not act should be removed, because it would be in the way of the wire coming off the reel to enter the draw-plate. When the whole wire has passed through one hole, the other barrel is put into its place, the wire is sharpened anew, the draw-plate is turned, the wire passed through the next following hole in size, drawn with the pincers, and fixed to the second barrel, which is turned by its handle, so that the wire unwinds from the first barrel, passes through the draw-plate, and winds on the second. It is necessary to take care that the wire be always passed through the grease box before entering the hole in the draw-plate.

One thing essential to be observed, is, that the wire passes through holes corresponding to its size, so as to require but little power to pull it through, consequently, the diameter of the wire is reduced but a very small quantity each time it passes through a hole in the plate.

To draw the wire of two-thirds of a line in diameter, it is necessary to anneal it twice before reducing it to one-third of a line: brought to this size, it is annealed by the method before described, and afterwards it will not require annealing to be reduced to the greatest degree of fineness. In order that the iron wire may possess the proper degree of ductility and tenacity to form a sonorous string, it must pass five or six times through the draw-plate after the last annealing. When the iron wire is reduced to the desired size, nothing more is requisite than to give it the necessary polish and white colour, that it may render clear and distinct sounds.

Polishing and whitening of the wires.

When the wire is drawn down to the proper size, the draw-plate and grease box are removed, the wire is fastened to the vacant barrel, and wound upon it, making it glide at the same time through a piece of leather previously rubbed on rotten stone. It is frequently necessary to repeat this operation to obtain a fine polish. The method of winding the wire on bobbins it is needless to describe. The size of the bobbins depends on the number desired to the pound weight.

Yellow wires.

The implements necessary for making these are the same as for the white wires, and they are used in the same manner: the only difference is in the polishing and annealing.

To obtain good yellow wires, we must employ only brass, composed of four-tenths of copper, three-tenths of old brass (*mitraille jaune,*) and three-tenths of calamine. This brass should be of a pure yellow colour; it may be procured at the manufactories in rods of a line in diameter. It is to be annealed once, by heating it in the furnace, placing it on the grate, putting white wood above and below it to obtain a clear and gentle fire. It is to be heated for an hour or two so as to be only red hot. On taking it out, it should be dipped for a moment into a boiler of hot tallow. It is afterwards allowed to cool completely, and is then passed through the draw-plate in the way already described for white wires.

The brass wire is polished by the process before mentioned, excepting that instead of rotten stone we employ red tripoli.

Strings or wires made by these methods will stand in tune a tone and a half higher than the wires of Nuremberg.*

[*Description des Brevets.*

French patent granted to M. Derepas, *of Paris, for a peculiar composition of Phosphorus Match Lights.*

Into a large flask heated in a sand bath, put eight parts of pure phosphorus, which you are to half melt, without allowing it to oxidize. After it is dissolved, add four equal parts of magnesia: mix the whole for an hour at the heat of 90 degrees of Réaumur (=234.5 F.) and moderate the fire in proportion as the operation is terminated. When cooled to from 30° to 33° (=99°.5 to 106.25,) this composition forms a sort of fat powder, which is put into bottles, and, when cold, carefully stopped. This substance forms an opaque body fit for inflaming a common match. [*Ib.*

French patent granted to Messrs. Michaud Laronte *and* Depuis, *of Paris, for the invention of a method of Plating Copper (cuivre) with Platina.*

Take 123 grammes (= 1899.6 grains) of fine silver, which you are to prepare for solution by the addition of 490 grammes (=7567.6

* It reflects but little credit on English wire drawers, that a large portion of the iron wire used by our numerous and eminent piano forte makers, is Berlin wire. It appears, however, that some manufacturers of Birmingham have been able to furnish a small supply of steel wire, said to be of superior quality in regard to tone and tenacity. During the last twenty years piano forte makers have gradually increased the diameters of their wires to obtain a fuller tone, and it is to be regretted that they have no fixed gauge of sizes generally understood. Brass wire is now commonly whitened by tinning.—Tech. Rep.

E. grains) of nitric acid at 48° (= 1.50 specific gravity, at 55° F.:) introduce them into a matrass, and expose it on a sand bath over a continued fire, till the silver is perfectly dissolved.

Afterward prepare, in a porcelain capsule, 490 grammes of white tartar, and the same quantity of marine salt. When these substances have been pulverized together, pour the solution into the capsule and stir the whole with a wooden spatula, till a perfect mixture is obtained. This composition is used for preparing the copper intended to be plated: for this purpose, the copper is first cleaned, and this composition is afterwards applied to it to whiten it. This application being made, with the assistance of a flat and very clean piece of cork, upon the metal, the latter is afterwards enveloped by a leaf of virgin silver, and exposed to the action of a well closed air furnace. Let it heat to a degree above cherry red. Apply, by means of a burnisher, and rub on the plate without taking it out of the furnace, and this will apply the substance on the copper-plate. When the whole forms only one body, pass it between laminating rollers, to give it the consistency of a solid body. This first operation terminated, the leaf of platina is prepared of the proper size for the copper-plate intended to be covered, so as to envelope it, and both are cleaned with sand, to remove any grease they may have on them, and dried with clean linen, that there may be no moisture remaining. The copper is then enveloped by the platina foil, in the same manner as it was before enveloped by the leaf of virgin silver, and submitted to the action of the same furnace as before, rubbing also in the same way with the burnisher, which applies the platina. [*Ib.*

FRANKLIN INSTITUTE.

Monthly Meeting.

The stated monthly meeting of the Institute was held at their Hall on Thursday evening, July 22, 1830.

Mr. S. J. Robbins was appointed chairman, and

Mr. F. Fraley, recording secretary pro tem.

The minutes of the last meeting were read and approved.

The following donations were presented to the Institute, viz.

By R. M. Lewis, Esq.

The 7th, 9th, 10th, and 11th Annual Reports of the Chesapeake and Delaware Canal Company.

By Matthew Carey, Esq.

British Magazine, for 1800, 2 *vols.*

Annual Reviews, and History of Literature, for 1804 *and* 1805, 2 *vols.*

Gentlemen's Magazine, and Historical Chronicle, for 1805.

Essays on Political Economy, by M. Carey.

By Isaac Hays, M. D.

The Eighth Annual Report of the Chesapeake and Delaware Canal Company.

An Address on Internal Improvements.

Mr. Hemphill's Speech on Rail-roads and Canals.
An Elementary Treatise on Mineralogy and Geology, by Cleaveland.
The Polar Star of Entertaining and Popular Science.
By Professor A. D. Bache.
Brunton's Compendium of Mechanics, with additions by Renwick.
By Professor F. Bache.
Turner's Elements of Chemistry, with notes by F. Bache, M. D.
By Mr. Judah Dobson.
Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce, 1st and 2nd vols.
A Description of the Property of the Lycoming Coal Company.
By Mr. D. M. Hogan.
Jones' Views of London, Nos. 38, 39, 40, *and* 41.
By the New York Historical Society.
The Transactions of the Society, in 5 vols.
By Mr. Charles Toppan.
A specimen of bank note engraving.

The corresponding secretary laid on the table the following works, received in exchange for the Journal of the Institute, viz.
Recueil Industriel, for February, 1830.
Bibliothéque Physico-economique, for April, 1830.
London Journal of Arts and Sciences, for May, 1830.
The Mechanics' Magazine, for April.
The Repertory of Patent Inventions, for May.
Gill's Technological and Microscopic Repository, for May.
The American Journal of Education, for June and July.
Boston Mechanics' Magazine, for June.
Mechanics' and Farmers' Magazine of Useful Knowledge, for July.

The committee appointed to draft rules and regulations for the government of the library and reading room, presented their report, accompanied by a set of regulations, which, after several amendments, was referred to a committee of three members to be engrossed, and the same committee were instructed to report rules for the government of that class of the library which is intended for circulation.

Adjourned.

S. J. Robbins, *Chairman.*
F. Fraley, *Recording Secretary, pro tem.*

On the principles which should govern the location and construction of Rail-roads. By Col. S. H. Long, United States Engineer.

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Sir,—I take the liberty to offer for publication in your valuable Journal, the following observations, which, although prepared more especially in reference to the Baltimore and Ohio Rail-road, nevertheless exhibit a variety of information applicable to rail-roads in general. The principles therein advanced may be applied with equal

propriety, in the location and construction of other similar works, by changing the data and deductions according to circumstances.

S. H. Long.

Extract from the original manuscript of Col. Long, of the United States Engineers.

I. *On the transverse dimensions of rail-roads.*—The usual width of rail tracks in England, is about 5 feet from *out to out* of the rails, or 4 feet 6 inches between the rails, with the addition of about one inch for play between the flanches of the wheels and the rails; the width of the Quincy rail-road is also about 5 feet between the rails, and that of the rail-road at Mauch Chunk, 3 feet 7 inches.

We would suggest 4 feet 6½ inches as the width between the rails of each rail track, half an inch of which is allowed for play between the rails and the flanches, and the residue for the distance between the flanches of the wheels. Also to have the width of each rail 2½ inches, making the aggregate width of a rail track 4 feet 11 inches.

A double rail-way, of course, will require double the width just mentioned, together with a space of at least 2 feet between the inner rails of the two tracks—making the width of the double rail-way 12 feet, and in addition to the width here given, the road-way should be formed outwardly of the tracks about 3 feet on each side, for the purpose of giving a firm and stable support to the rails. Thus the entire width of the road will be 18 feet, which will admit loads occupying a width of 7 feet to pass each other on the rail tracks. In situations where additional tracks, *turns out* or *via-fuges* are required, 6½ feet must be added for each additional track.

Two modes of construction are proposed, one applicable in situations where a solid and stable foundation can be had, and the other where embankments are necessary in forming the road bed, which may require much time in settling and consolidating. The former consists in forming the bed of the road upon the natural surface, or by excavation in such a manner as not to disturb the natural solidity of the earth; or by constructing the bed of stone, so as at once to constitute a stable foundation.

Having prepared the bed of the road, trenches 18 inches to 2 feet wide, are to be formed for the reception of stone rails resting upon broken stones; the rubble stone is to be laid in the trenches to the depth of 6 or 8 inches; and stone rails, 3 to 6, or 8 feet long, 12 to 15 or 18 inches broad, and 6 or 8 inches thick (undressed except at the ends, which must be squared so as to form a fair junction at least at their upper edges,) are then to be laid edgewise in the trenches, and adjusted to a full and equable bearing upon the rubble stone.

Paving stones reduced to the size of stones proper for the construction of a M'Adamized road, are then to be thrown into the trenches on both sides of the rails, and upon the road bed to the entire width above mentioned, raising it nearly to the upper edge of the rails. The pavement is then to be consolidated by ramming, or

by passing loaded rollers over its surface, both inwardly and outwardly of the rail-tracks—the process of consolidation being carried on till the pavement shall have become not only solid, but impervious to water, the latter of which will be effected by the detrition of a quantity of the stone sufficient to fill the interstices between the fragments; and the stone rails are then to be dressed to the width of about 2½ inches, on their upper surface, in exact conformity to the plane of the road.

Plate rails of wrought iron in bars, 8 to 12 feet long, 2½ inches wide, and ¼ an inch thick, are then to be applied to the stone rails, and confined by means of iron rivets $\frac{5}{16}$, or ⅜ inch in diameter, and 9 to 12 inches asunder, passing through the plates and into the stone 2 to 2½ inches, being cut at suitable lengths, and rivetted into counter sinks formed in the upper side of the rail.

In order to obviate the expansion and contraction of the plates, by heat and cold, which may be expected in this climate to amount to nearly ¼ of an inch for every 10 feet in length, it will be proper to have all of the holes perforated in the plate for the reception of rivets, except that midway of the plate, of an elliptical form, the conjugate diameter being about $\frac{1}{12}$ of an inch longer than the transverse.

Scuppers for draining the water from the surface of the road between the rails, may be formed at intervals of 3 or 4 hundred yards along the road, by leaving a space 3 or 4 inches wide between the ends of the stone rails. These spaces, or water ways, may be bridged, by a plate or bar of iron 5 or 6 inches long, rivetted to the lower side of the plate rail, and resting in notches or steps prepared for their reception in the ends of the stone rails.

The plate rail should be moulded into a particular shape on that side intended for the wheel tread. The following form is deemed appropriate, viz. the bottom of the rail flat, and 2½ inches wide, the sides perpendicular to the base or bottom, and rising $\frac{5}{16}$ inch above it, the upper corners rounded to a quadrant on a radius of ¼ of an inch, and the top or upper surface, exclusive of the rounded corners, being curved or crowning, so as to form an arch $\frac{1}{32}$ of an inch high on a cord of two inches, so that the entire depth or thickness of the plate from its crown to its soal may be ½ inch.

It should also have been stated in connexion with our remarks on the formation of the road, that after the plates shall have been made fast to the stone rails, any portions of the latter jutting inwardly so as to interfere with the free passage of the wheel flanches, must be removed by chipping, or otherwise reduced.

It is believed that the mode of construction above suggested, is calculated to give works of this kind a degree of stability and permanency equal to that attained by any that have ever been constructed. It has been adopted in part on the Quincy rail-way, where its efficiency has been satisfactorily tested, while the cost attending its application is far less than that unavoidable in the construction of the ordinary iron rail-way.

We take this opportunity to observe, that the application of a

cheap and durable cement—could one of a suitable consistency be devised—in adjusting the plates to the stone rails, so as to give the former an equable and fair bearing, would greatly facilitate, and render much less expensive, the construction of a rail-way in conformity to the plan proposed.

The other mode of construction alluded to, is intended to be applied merely in situations where a temporary structure is adviseable, in order to allow the substratum of the road to settle, and consolidate, before a work of a more permanent character can be advantageously substituted. It consists in grading the road in the same manner as for stone rails. But instead of trenches for the reception of the rails, &c. wooden sleepers are to be laid, 4 feet from centre to centre, transversely to the road, furnished with notches for the reception of wooden rails, and keys for confining them. The sleepers may be of round timber, or may be formed by splitting a timber tree into quarters, provided, in the former case, the diameter of the smaller end is not less than 7 inches, and in the latter, that the diameter of the log at the smaller end, before it is slitted or split, is such that it will form a square of 13 inches upon each side; their length should be at least 8 feet for each track, or 14 feet in situations where a double track is required. In cases where one or more *sidelings* are required, an additional width of 6 feet 2 inches must be added for each track. The sleepers should be of locust, mulberry, or cedar, and the keys of white ash, locust, or hard pine, the latter of which is deemed preferable on account of its adhesive and elastic consistency. The rails should be of oak, hard pine, or chesnut scantling, well seasoned, 6 inches square, neatly dressed, and 8, 12, 16, or 20 feet long, confined in the notches of the sleepers by means of the keys above mentioned. These rails, like the stone rails above mentioned, must be furnished with iron plates, of the size and description heretofore mentioned, applied to the inner edge of the wooden rail of each track, by means of nails about 3 inches long, or wood screws of a suitable length, passing through the plates, and entering the wooden rail. The sleepers and rails being laid upon the bed of the road, rubble stone or gravel is to be applied after the manner of a pavement, so as to fill the spaces between the sleepers, and form a regular and solid covering for the road bed, rising nearly to the upper surface of the rails. This mode of construction is intended to be applied solely in cases of embankment, with the view of having stone rails plated with iron, substituted for those of wood, whenever the embankment shall have settled, and acquired solidity, and the wood work shall have decayed.

Turns out, or *via-fuges* and sidelings, should be formed at intervals not exceeding a mile each, in order that carriages may pass from the main track, and leave it unobstructed while they may be detained for the discharge or reception of loading, passengers, &c. or for any other purpose. At every town or village site, and in the vicinity of points at which the rail-road is intersected by highways, double sidelings, or, one on each side of the road, should be provided

for: but in other situations, a single sideling, located between the main rail tracks, will be sufficient as a resting place for both tracks.*

In regard to the power required for the conveyance of a single load upon a level rail-road, we shall merely offer a few results deduced from experiments made in reference to this subject, in England, where it is probably better understood than in any other country.

Agreeably to experiments made by Mr. Tredgold, who employed for this purpose a set of apparatus on a small scale, a force, power, or traction of one pound, is sufficient to drag, on a horizontal road, a weight or load of 130 pounds. But Mr. N. Wood, who made his experiments on a rail-road of the ordinary dimensions and construction, ascertained that a power or traction of one pound, was sufficient to propel, on an average, 200 pounds on a level road. The resistance to locomotion on roads of the description above given, (as exemplified on the Quincy and Mauch Chunk rail-ways) is no doubt considerably greater than that on the iron roads upon which Mr. Wood experimented. On the Mauch Chunk road, the average descent is about one degree, or 92 feet per mile. The resistance thereon is such, it is believed, that the carriages would not descend of their own accord, were the declivity less than about 50 feet to a mile, whereas, were the friction no greater than that attending Mr. Wood's experiments, the declivity for spontaneous descent, would not exceed 26.4 feet in the distance of a mile. We shall accordingly assume 150 pounds as the appropriate load, for a power or traction of one pound on the contemplated rail-road, with wheels 3 feet in diameter. Agreeably to this assumption, the declivity required for the spontaneous descent of the load, will be 35.2 feet in a mile. Hence, the power of a horse being estimated at 112 pounds, the appropriate load for one horse on a level road would be $7\frac{1}{2}$ tons, and on a road ascending at the rate of 35.2 feet per mile, half that load. A more particular discussion of this subject will be attempted in the sequel of this essay.

II. *The principal impediments in the way of easy and cheap construction*, are, first, undulations upon the surface of the ground; second, ravines and water courses; third, precipices and abrupt slopes; fourth, inundations and freshets; and fifth, the ascent of hills and mountains; which last is to be regarded as an impediment in the way of transportation rather than of construction, and will be considered under our third general head. These several subjects will be discussed separately, in the order above given.

1st. Of undulations on the surface of the ground.

It is a well established principle, that in the location of rail-roads, horizontal flexures, giving to the line of the road a serpentine character, are admissible, but that vertical curvatures occasioning an alternation of ascents and descents, should be avoided as much as possible. Hence it is obvious that the line of the road should be kept, as nearly as may be practicable, in the same plane, and that

* It is to be understood that the space between the main tracks is to be enlarged, to a width sufficient to accommodate the intermediate track, contemplated by this arrangement.

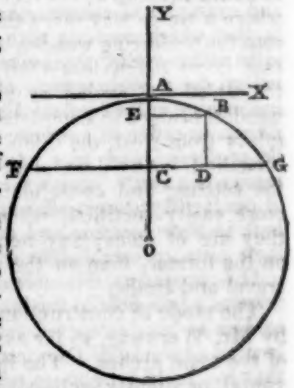
hills, and other inequalities of surface, should either be avoided by passing them in a circuitous direction, or by *deep cuts* and embankments, or bridges leading across them. As to the preference to which either of these modes of traversing an undulating surface may be entitled, it will depend in a great measure upon the following circumstances, viz. the extent of the contemplated work, the amount of capital to be invested in its accomplishment, the amount of travel and transportation to be provided for; and the despatch with which they are to be executed. In reference to this subject, however, it may with propriety be observed, that in this country, where the field for improvements of the kind under consideration is unbounded, and examples of construction exceedingly rare, the safest mode will be that which consists with the greatest economy of construction, or in other words, that, whenever the expense of avoiding a hill or valley, by a prolongation of the route, in a manner to maintain a uniformity in its vertical direction, is less than that of *cutting* and *filling*, in order to preserve the same uniformity, the former should be preferred, and *vice versa*. This manner of deciding upon the merits of a route, seems the more plausible and proper, on account of the facility always afforded by rail-roads, of making improvements both in their location and construction, at any period subsequent to their primary establishment.

It is proper on this occasion, to offer a few remarks on the curvatures admissible in the location of a rail-road; a subject that seems seldom to have attracted the particular notice of authors who have treated of works of this nature. Agreeably to the best intelligence that can be had of those who have visited and examined the rail-roads of Great Britain, it is believed that curvatures of a radius not exceeding 250 or 300 feet, are frequently to be met with in that country. On the Quincy rail-way, near Boston, Massachusetts, the least radius of curvature is said to be 300 feet. On the Mauch Chunk rail-road, the most abrupt curvature on the main line is that indicated by a versed sine of 22 inches, to a chord of 80 feet, which is equal to a radius of about 437 feet. Curvatures of any radius, however great, are nevertheless to be regarded as defects in rail-roads, but it is at the same time manifest, that the inconveniences attending them become less, as the lengths of the radii increase, and become quite imperceptible, when the radius has an extent of five or six hundred yards. The inconveniences alluded to, in addition to an increased length of road, results mainly from the difference of the length between the interior and exterior rails of the curve; which, from the manner usually observed, in constructing rail-road carriages, occasions a longitudinal sliding or friction equal to that of dragging half the load without wheels through a distance equal to the difference in the length of the rails. It is believed, however, that this difficulty may be obviated almost entirely by a different arrangement in the construction of carriages.

The following tabular statements, having for their object, not only the dimensions of curves, but the means of applying them in the location of a road, will conclude our observations under this head.

The statements alluded to have been prepared by Mr. Guion, assistant civil engineer, as exhibited in the following communication.

Sir,—Agreeably to your request, I herewith furnish you with a mode of describing arcs of circles, of known curvatures, by a series of points, determined from the length of ordinates to given abscissas, or portions of the assumed chord; to which is affixed a tabular form, displaying the radii, versed sines and ordinates, of four circles, corresponding to a constant chord of 100 inches, feet, or yards; the abscissas beginning at the middle point and increasing by 5, on either side, to 50.



The curvature being assumed, the radius and versed sine corresponding to the given chord, will be known.

Then let AO $= r = 626$, CG $= 50$, AC $= 2$, AE $= x$, EB $= Y$. Then when the point B is referred to A as the origin of co-ordinates, the equation of the circle is $y = \sqrt{2rx - x^2}$ or $x = r - \sqrt{r^2 - y^2}$ from which to determine the same point when referred to C as the origin, drawing BD perpendicular to CG, we have CD $=$ EB $= y =$ successively 5, 10, 15, etc. to 50; and BD the required ordinate $=$ EC $=$ AC $-$ AE $= 2 - x$. Then determining x from the equation $x = r - \sqrt{r^2 - y^2}$, in which y and r are known, BD found.

To find x, we have $r - x = \sqrt{r^2 - y^2}$

$$\text{L}\,(r - x) = \tfrac{1}{2}\,\text{L}\,(r^2 - y^2)$$

$r^2 - y^2 = 391851$ for 1st five feet.

then L $(r - x) = 2.796\ 5605$

$r - x = 625.98$

$x = 626 - 625.98 = .02$

And BD $= 2 - x = 2 - .02 = 1.98$. In the same way will be found the remaining ordinates; the last one being, of course, equal to zero.*

Very respectfully, &c.

(Signed,) W. B. Guion.

To Col. S. H. Long.

2nd. Of ravines and water courses.

This head is intended to embrace all situations where culverts and bridges are required, in the formation of a road. In the construction of these appendages, two things are to be considered, viz. an extent of span sufficient to admit a free passage of the water under them; and a height corresponding to that of the *plane* traversed

* For a more full and satisfactory method of locating curves, and computing the lengths of ordinates, see Long's "Rail-road Manual," published in 1829.

by the road. In reference to culverts, it is proposed to construct them of stone, none of them having a span greater than 10 feet. The culverts may be divided into two classes, viz. those of six feet and upwards, to be formed of abutments and arches, constructed in the usual manner, of stones laid in grout or mortar; and those having a span less than six feet, to be constructed after the manner of the gothic culverts on the national road, westward of Wheeling.

With respect to bridges, it is proposed to construct them of timber resting upon stone abutments and piers, yellow pine being most convenient, and best adapted to this purpose. It is also proposed, as above intimated, to erect bridges of this character, in all places where a water way more than ten feet wide is required. The reasons for preferring wooden bridges, are briefly as follows: their prime cost is so much less than that of stone bridges; the interest on the additional capital required for the latter, is sufficient to keep wooden bridges in complete repair; stone bridges are more liable to injury from frost, the dilapidating effects of which cannot always be remedied. Any derangement in the line of the road, occasioned by the settling and consolidation of the abutments and piers, can be more easily rectified, when the bridges are of wood, than when they are of stone; any necessary repairs can be more easily made on the former, than on the latter, and with less obstruction to the travel and traffic.

The mode of construction deemed most applicable, is that adopted by Mr. Wernwag, so far as relates to the formation and adjustment of the main arches. The flooring of the bridge must be either horizontal, or slightly inclined, and may be located either in coincidence with the chord, or at any elevation above or below it, and may be sustained either by stirrups depending from the arch, or struts connected thereto.

In order to facilitate repairs, and afford the best opportunity for renewing the bridge, it is proposed to support each rail track upon two arches; the width allowed therefor being 10 feet, or the entire width for both tracks 20 feet, which will afford sufficient room for a foot way, between the tracks. The inside arches of the rail-ways, may be united to each other by temporary fastenings, which being detached, the road-ways will be independent of each other, and either of them may be repaired or renewed while the other remains firm, and may subserve the purposes of travel and transportation.

As to the other dimensions, quantity of materials, &c. necessary in the construction of bridges, so much is dependent on the locality, height, and length of the spans, that no estimate in reference thereto will be attempted on the present occasion.

3d. Of precipices and abrupt slopes.

Any route leading across the Alleghany mountains, must unavoidably be attended by numerous impediments of this nature. Those most formidable are the rocky and precipitous banks of the streams, which often present perpendicular fronts of great height, while their immediate bases are washed by copious streams, occa-

sionally swelling into torrents. The passage of these by a rail-road must necessarily be effected at great expense, in procuring sufficient space for the road-way, and in preparing the foundation of the road.

To the difficulty of forming the road-bed, in situations of this kind, may be added that of securing the work from avalanches of earth or stones, to which it will be more or less exposed, and which cannot well be guarded against, by any other method than that of increasing the width of the road. This is to be effected mainly by erecting side walls of greater or less height, for the support of the road, and by forming a broad drain between the rail track and the hill side, sufficiently large for the reception of the earth and stones, that may slip from the surface of the hill.

4th. Of inundations and freshets.

Perhaps no part of the work will be attended with greater difficulty, or require more care in the execution, than that of raising the road above the reach of freshets, and protecting it from the violence of currents of water. In numberless instances, the low grounds and flats contiguous to water courses, and subject to inundations, must unavoidably be traversed by the road, which in such instances must be elevated to a considerable height above the surface of the ground. In other situations, the road must be conducted along the sides of precipitous shores, against which the current, especially in a high stage of water, impinges with great force, in which case strong walls, based on the bed of the river, and rising to the utmost height attained by the stream when swollen by a freshet, must be formed of heavy stones; and in situations where it is exposed to the action of drift and floating ice, it may be necessary to confine the stones together by means of iron clamps.

The ranges from extreme low to extreme high water, vary from 10 to 40 feet, requiring walls of a corresponding height, for the support and protection of the road. It is believed that these walls, in order to withstand the action of the frost, and sustain, without yielding, the weight of the materials of which the road is formed, ought to have a thickness, at top, of at least 18 inches, and a batter or talus on their fronts of about $\frac{1}{4}$ of the height. Hence the base of a wall 10 feet high, should be at least $3\frac{1}{2}$ feet thick, and that of a wall 30 feet high should be $7\frac{1}{2}$ feet thick, and in due proportion, when different heights are presented.

III. The passage of hills and mountains, of an extent and elevation too great to be traversed by a deep cut, or perforated by a tunnel, must be regarded as the most serious impediment in the way of easy transportation. The difficulties that present themselves in view of this subject, are those attendant upon ascents, in which a portion of the gravity of the load is to be overcome in addition to the friction, as heretofore stated, and those attendant upon descents, where the gravity in the direction of the line of descent, is greater than the resistance by friction. In the former case the power required for locomotion must be increased in due proportion to the angle of ascent, and in the latter, the excess of gravitation above the friction must be counteracted by suitable brakes or convoys, in

order to prevent the too rapid descent of the load. In reference to the former, it may also be observed, that the advantages of a rail-road over those of an ordinary turnpike, decrease as the angle of ascent increases; or, in other words, that these advantages become less, in proportion as the gravity in the direction of the inclined plane increases, or as the portion of the load sustained by the plane diminishes; and in reference to the latter, that when the descent exceeds 35.2 feet per mile, brakes attached to the carriage, and acting upon the peripheries of the wheels, will be adequate to the retarding and regulating of the descent, in all states of the weather, frost and snows excepted, provided the declivity does not exceed an angle or declination of three degrees; also, that in all cases of a more abrupt descent, stationary convoys or brakes must be employed, in order to regulate the speed of a descending load. In regard to the means of overcoming ascents, they will be more or less expensive in proportion to the absolute height to be attained, except in cases where an *adequate water power* may be conveniently had for that purpose; while those of descending, in addition to the cost of suitable convoys, will simply be attended by the expense of conveying the motive power, or the means of generating it, from the top to the bottom of the declivity unincumbered with a load; which in case of horses being employed on the inclined plane, will be considerable, but in cases where the ascent of the plane is overcome by stationary machines propelled either by steam, horses, or water, this inconvenience may be avoided. In conformity to the intention heretofore expressed, it will be proper on this occasion, to explain more fully our views in reference to the application of motive power, and the mode of estimating it, not only in relation to the ascent of inclined planes, but to the conveyance of burdens upon a level road. It has already been stated, that a power of one pound, acting horizontally, is regarded as adequate to the conveyance of 150 pounds on a level rail-road of the description heretofore given. The means of generating this or any other amount of power, and the velocity with which it is to act, now claim some attention. In regard to the former, three varieties are presented, viz. animal, steam, and water power; the first and second being applicable, not only through the medium of stationary machinery, but in a manner to partake of the locomotion of their load, and the third, applicable only by means of stationary machinery. Horses and mules, the latter being esteemed more hardy, more easily subsisted, and equally efficient, though less rapid in their movements than horses, seem to be the only animals hitherto employed on rail-roads. Various degrees of strength have been attributed to these animals, and especially to the horse, whose powers have been variously estimated, by authors who have experimentally investigated this subject, with the view of ascertaining the average amount of labour that can be performed by a horse to the greatest advantage. These investigations have induced a variety of results, the mean of which appears to be as follows, viz. that the force, stress, or traction, of a horse moving at the rate of 2 miles per hour, during 10 hours of each day, is equal to 112 pounds; also,

that when the daily duration of his labour is less than 10 hours, the degree of traction will be proportionably greater, till it amounts to about 200 pounds, and when his movements are accelerated beyond the speed of 2 miles per hour, his power will be proportionably diminished.

In order to place this subject in a clearer point of view, we shall here insert, in a tabular form, a few of the conclusions drawn from a great variety of experiments, as recorded by Mr. N. Wood, in his "Practical Treatise on Rail-roads;" by Mr. T. Tredgold, in his Treatise on the same subject, and by Professor Leslie, in his Elements of Natural Philosophy. The following table exhibits the greatest useful effect of the labour of a horse moving at different rates of speed, as deduced from the works of the judicious and ingenious authors, above cited.

WOOD.				TREDGOLD.				PROF. LESLIE.			
Speed in miles per hour on a level rail-road.	Daily distance in miles performed by a horse.	Power of 1 horse moving with different velocities.	Daily duration of labour in hours.	Speed in miles per hour on a level rail-road.	Daily distance performed by a horse.	Power of 1 horse moving with different velocities.	Daily duration of labour.	Speed per hour on a level rail-road.	Daily distance travelled by a horse.	Power of 1 horse moving with different velocities.	Daily duration of labour.
Miles.	Miles.	Poun's	H'rs.	Miles.	Miles.	Poun's	H'rs.	M'ls.	M'ls.	Poun's	H'rs.
2	20	112	10	2	18	125	9	2	20	100	10
3	20	74 2/3	6 2/3	3	18	83 1/3	6	3	20	81	6 3/4
4	20	56	5	4	18	62 1/2	4 1/2	4	20	64	5
5	20	44 4/5	4	5	18	50	3 3/5	5	20	49	4
6	20	37 1/3	3 1/3	6	18	41 2/3	3	6	20	36	3 1/4
7	20	32	2 6/7	7	18	35 5/7	2 4/7	7	20	25	2 2/7
8	20	28	2 1/2	8	18	31 1/4	2 1/4	8	20	16	2 1/2

The discrepancies between the statements of the table, so far as relates to the views of Messrs. Wood and Tredgold, are very inconsiderable. The expressions indicating the power of a horse at different rates of speed, may be regarded as practical deductions, from experiments made with the utmost care and precision for the purpose of ascertaining the "*greatest useful effect*" resulting from the labour of that animal. The statements ascribed to Professor Leslie, are made agreeably to the formula furnished by that gentleman, for computing the power of a horse at different velocities, and are to be regarded rather as theoretical than practical.

It may be inferred from the foregoing table, that a horse, moving at the rate of 2 miles per hour, is able to communicate a force twice as great as when he moves at the rate of 4 miles an hour, and four times as great as when he moves with a speed of 8 miles per hour. Or, that the number of horses required to drag a given load, must be doubled when the speed is doubled. This rule, however, is only

applicable to velocities above that at which a horse can exercise his full strength to the greatest advantage, which is supposed to be the case when he travels at the rate of about 2 miles per hour, as before mentioned.

A course of reasoning, somewhat analogous to that we have been pursuing, is also applicable to the ascent of inclined roads, where a portion of the horse's gravity, as well as that of his burden, constitutes a part of his load. If we suppose the weight of a horse to be 800 pounds, and the angle of ascent 8 degrees, the force exerted by the horse in ascending without a load is equal to 112 pounds, the same as that required to propel 7¼ tons on a level rail-road as heretofore stated. Accordingly, that portion of the power of a horse applicable to the conveyance of a load, over and above that which is necessary to his own progression upward on an inclined road, varies in due proportion to the angle of the ascent, till it vanishes or becomes extinct at an angle of about 8 degrees.

However discordant with common experience may seem the opinions we have advanced, both in relation to the power of a horse moving at different rates of speed, and in ascending inclined roads, yet it is confidently believed that they are correct, in so far as they relate to the "*greatest useful effect*" resulting from the labours of that animal; his welfare, duration of life, and continuity of service being equally consulted.

Notwithstanding the principles adverted to in the foregoing discussion, and the propriety of regarding velocity of movement, duration of labour, and degrees of acclivity as elements materially affecting any practical results that may be deduced in reference to the questions that have just been agitated, and especially to the application of animal power; yet for the sake of simplifying our calculations as much as possible, and divesting them of minute and intricate details, we shall regard the power of a horse as equal to a stress or traction of 112 pounds, moving at any desirable velocity, whether upon a level, or upon an ascending road. This view of the subject is altogether appropriate, with respect to the application of mechanical power, and is equally so with respect to animal power applied through the medium of stationary machinery; due allowance being made in both cases for the friction of the ropes and other extra machinery necessarily employed.

A system of graduation, corresponding to such an inclination in the rail tracks, that a given power may be sufficient to propel, in addition to the carriages, five times the amount of tonnage in the direction of the heaviest trade as in that of the lightest trade, now claims our consideration.

Were it possible to construct a rail-road, throughout its whole extent with a uniform graduation corresponding to the amount of tonnage in opposite directions, whatever might be the motive power required for the traffic, the graduation would still be the same. When, however, such an arrangement is utterly impracticable, we must of course resort to such a system of graduation as the nature of the case will admit, keeping in view economy of construction and

transportation, facility and despatch in both, the accommodation of the public, together with an adequate profit to the stockholders, upon their investments. In accordance with these views, we present the following system of graduation, to be adapted to the location of the road, according to the circumstances affecting the condition of the route, with respect to ascents and descents, and in conformity to the state of trade thereon, which, as before mentioned, is assumed to be in the ratio of 1 to 5.

1st. Of the graduation adapted to the state of trade to be adopted in all cases where the natural surface has an inclination corresponding thereto. The object in view, under this head, is, to determine the degree of ascent or acclivity, at which the relative amounts of transportation may be attended with equal resistance in both directions. The elements upon which any calculation of this nature must be based, are as follows, viz. The proportion between the outward and return transportation, which we shall assume at the ratio of 1 to 5, which is intended to imply, that for every ton conveyed westward, five tons will be conveyed eastward; the proportion of the weight of a carriage to that of its full load, which we shall estimate in the ratio of 1 to 3, implying that a carriage weighing one ton may be made sufficiently strong for the conveyance of a load weighing three tons; and, the ratio of the weight or load, to the power necessary to propel it, which we shall assume as heretofore stated, as 1 to 150, implying that a traction of one pound is sufficient to propel on a level rail-road, a load of 150 pounds.*

The result deducible from the foregoing data, is, that the inclination of the road will be at the rate of 15.086 feet per mile, or 9.8 minutes of a degree.

Inasmuch as the natural surface of the ground will not always admit of a location in accordance with the results above stated, we are compelled to resort to a more complicated system of graduation, in order to effect an economical construction of the road by adapting its location to the natural surface, in such a manner as to avoid as much as possible, deep excavations and high embankments, and at the same time render the application of motive power, whether animal or mechanical, more easy, uniform and systematic. For these purposes we shall exhibit in a tabular arrangement, a series of statements based upon the data assumed agreeably to the views advanced in the preceding articles, and embracing results sufficiently varied for ordinary purposes.

* In reference to the friction of carriages upon rail-roads, subsequent experience has taught, that the ratio of the resistance upon a horizontal rail-road substantially constructed, to the load is as *one to two hundred.* Accordingly the declivity for spontaneous descent will be at the rate of 26.4 feet per mile, and that corresponding to a reciprocal traffic, where the outward is to the return transportation as 1 to 5, will be at the rate of 13.2 feet per mile.

Hence corresponding changes in the "table of graduation" hereinafter to be given, may with propriety be introduced.

Table of graduations, computed for equal resistance in both directions.

OUTWARD TRANSPORTATION.						Amount of resistance or power required for transportation in either direction.		RETURN TRANSPORTATION.					
Weight of carriages, 3.28125 tons. Do. of freight, 1.96875 tons. Amount of friction, 0.03499 tons.								Weight of carriages, 3.28125 tons. Do. of freight, 9.84375 tons. Amount of friction, 0.08799 tons.					
Statements.	Horses.	Inclination of plane in feet per mile.	Inclination of plane in degrees and minutes of a circle.		Gravity of the load, or its tendency to descend, expressed in parts of a ton	Resistance in parts of a ton.	Resistance in pounds.	Gravity of the load, or its tendency to descend, expressed in parts of a ton	Inclination of plane in degrees and minutes of a circle.		Inclination of plane in feet per mile.	Horses.	Statements.
No	No	Feet.	dg.	min.	prts of a ton.	Ton.	Po'nds.	prts of a ton.	dg.	min.	Feet.	No	No
1	0	35.2	0	22.9	0.035			0.088	0	22.9	35.2	0	1
2	1	15.08	0	09.8	0.015	0.05	112	0.038	0	09.9	15.08	1	2
3	2	65.37	0	42.5	0.066	0.10	224	0.012	0	03.2	5.02	2	3
4	3	115.65	1	15.3	0.115	0.15	336	0.062	0	16.3	25.14	3	4
5	4	165.94	1	48.0	0.165	0.20	448	0.112	0	29.4	45.25	4	5
6	5	216.22	2	20.8	0.215	0.25	560	0.162	0	42.5	65.37	5	6
7	6	266.51	2	53.5	0.265	0.30	671	0.212	0	55.6	85.48	6	7
8	7	316.79	3	26.3	0.315	0.35	748	0.262	1	08.7	105.59	7	8
9	8	366.08	3	59.0	0.365	0.40	896	0.312	1	21.8	125.71	8	9
10	9	416.37	4	31.7	0.415	0.45	1008	0.362	1	34.9	145.82	9	10
11	10	466.65	5	04.5	0.465	0.50	1120	0.412	1	48.0	165.94	10	11
12	11	516.94	5	37.2	0.515	0.55	1232	0.462	2	01.1	186.05	11	12
13	12	567.22	6	10.0	0.565	0.60	1344	0.512	2	14.2	206.17	12	13
14	13	617.51	6	42.7	0.615	0.65	1456	0.562	2	27.3	226.28	13	14
15	14	667.79	7	15.5	0.665	0.70	1568	0.612	2	40.4	246.40	14	15
16	15	718.08	7	48.2	0.715	0.75	1680	0.662	2	53.5	266.51	15	16
17	16	768.37	8	21.0	0.765	0.80	1792	0.712	3	06.6	286.62	16	17

In explanation of the foregoing table, we shall merely observe, that the elements from which it is computed, are introduced into the body of the table under the heads of outward transportation and return transportation, and that the several subdivisions into columns, are sufficiently explained by their respective *captions*.

It is proper to state, on this occasion, that in cases where a stationary steam engine, or other stationary power, is employed in the ascent of inclined planes, the number in the column headed "Horses," will indicate the numerical amount of horse power required for that purpose, on any inclination corresponding thereto, additional allowance being made for the friction of the ropes or chains, rope-rollers, &c. necessarily employed in connexion with stationary machinery.

In respect to the employment of steam power, we shall further observe, that fuel is to be regarded as its generating medium, and may with propriety be substituted for horses and their subsistence. This view of the subject will appear the more plausible, when it is understood, that the prime cost of a steam engine competent to perform the labour of 5 horses actually hitched, or that of 12 horses continuously, due allowance being made for intermission of their labour, will not exceed that of the horses necessary for the performance of the same labour, even at a speed of only 2 miles per hour.

If the speed be accelerated to 4 miles per hour, the same engine will be able to perform the labour of 24 horses; and with a speed of eight miles per hour, it will be able to perform the labour of 48 horses. However paradoxical these opinions may seem, they are nevertheless grounded upon the practical results drawn from experimental facts by Messrs. Wood, Tredgold, and Leslie, as stated in our tabular exhibit of the power of a horse moving with different velocities. In order to furnish a more clear illustration of this subject, we will add that the traction or draft of an engine being equal to 560 pounds, or the power of 5 horses, the former working continuously, and the latter only 10 hours of each day, the efficiency of the engine will be equal to that of the continuous labour of 12 horses, when the speed is only 2 miles per hour.

Again, the engine can move with a speed of 4 miles per hour, exercising a traction of 280 pounds continuously, whereas, the speed being 4 miles per hour, the daily duration of a horse's labour is only 5 hours, and his power of traction 56 pounds, consequently it will require 24 horses to perform the labour of the engine.

Again, the engine can move with a speed of 8 miles an hour, exercising a traction of 140 pounds continuously; whereas, the speed being 8 miles per hour, the daily duration of a horse's labour is only 2½ hours, and his force of traction 28 pounds, consequently it will require 48 horses to perform the labour of the engine.

N. B. The expense of steam will be precisely the same in all the cases above mentioned. It should moreover be observed, that in the foregoing comparisons, horses are regarded as moving with their loads at the several rates of speed therein mentioned, but that the steam power may act through the medium either of a locomotive or stationary engine.

Hence, although it may be questionable, whether animal or steam power should have the preference, in a slow movement, yet with a speed of 4 miles per hour and upwards, there can be very little doubt that the latter will prove most economical.

As to the quantity of fuel necessary to convey a given load through a given distance, it has been customary to allow one pound of coal, or $\frac{1}{20}$ part of a bushel, for the conveyance of a ton, through the distance of one mile on a level road; accordingly 7½ pounds per mile will be expended in conveying the load of one horse, or 150 pounds, which is equal to about 1¾ bushels, may be regarded as about equal to the daily performance of a horse, on a horizontal rail-road.

The former of these quantities, viz. 7½ pounds, being multiplied by the number of horses, corresponding to any given inclination in the tables of graduation, will give the quantity of coal required for the ascent of a plane of that inclination, whose length is one mile. Or, the quantity of coal required in surmounting heights, will be at the rate of one pound per ton for every 35.2 feet of elevation, in addition to what may be required to pass through any given distance upon the road.

In regard to the employment of water power, as a substitute for stationary steam power, there can be no doubt of its being attended

with very great advantages, in situations where a sufficient supply of water can be had at a suitable height.

The quantity required, must be about equal in weight to the tonnage passing upwards upon the road, at the place where a stationary power is required, provided the water can be employed in such a manner as to act through a perpendicular distance, equal to that through which the load is to be conveyed. In case the perpendicular distance is less, the quantity of water must be proportionably greater, but in case it is greater, the quantity will be proportionably less than the amount of tonnage ascending the inclined plane.

On the Manufacturing of Indigo in the United States. By William Partridge.

The value of the indigo consumed in this country, for the year 1829, cannot be estimated at less than two millions of dollars.

Of the quantity consumed, there was made in the United States about two hundred thousand pounds, or one-tenth part of the consumption.

As the consumption is rapidly increasing, from the increase of population, from the extension of manufactures already established, and from the introduction of new articles of manufacture, I consider it an object of national importance, that it should be better made, and more extensively cultivated in this country.

I have been acquainted with the indigo market for more than thirty years, and never remember it in so depressed a state as it has been for the last twelve months. The average price of the sales for the last year cannot have been much over one dollar per pound. The average price of the imported has been about one dollar and fifteen cents, and of that made in this country, about fifty cents. To endeavour to give such instruction to the planters as will enable them to make an article fully equal to the imported, is the object of this communication.

The quantity of indigo made from an acre of the plant, has been differently estimated by almost every maker from whom I have obtained information. Gen. Wade Hampton, who many years since made the article in South Carolina, informed me that he obtained sixteen pounds of fine indigo from the plant taken from a half acre, or thirty two pounds per acre. Other estimates make the quantity much larger, some nearly two hundred pounds to the acre. Taking the average of the different estimates, it would be at least fifty pounds. It will appear by this estimate, that it would require forty thousand acres of land to raise a supply for the present consumption; and as the demand is rapidly increasing, it is more than probable, that in ten years, it will require the product of eighty thousand acres to raise a supply for home consumption.

There are four points to be attended to in the making of indigo, which require much judgment, aided by practical skill. These are,

the time of cutting the plant, the degree of fermentation to be given in the steeper, the degree of oxidisement of the colouring feculæ, and the extrication of foreign matter from the pulp after the indigo is made. Three of these processes being purely chemical, it is not, therefore, surprising, that ordinary workmen should frequently fail in producing a good article. There is probably more loss sustained by our planters, from the ignorance of the operators, than the whole value of the article now sold.

The plant should be cut when at maturity, as it will then afford a fine colour; but if cut too late, a portion of the colour is then lost, and an indigo of worse quality is obtained. Mr. Dalrymple informed me, that the plant should be cut when in full flower, after the weather for some days has been dry.

Another celebrated maker of indigo, asserts, "that if the plants are suffered to stand till they run into flower, the leaves become too dry and hard, and the indigo obtained from them proves less in quantity and less beautiful—the due point of maturity is known by the leaves beginning to grow less supple, or more brittle.

It appears, that the makers of indigo differ as to the time of gathering the plant. It is greatly to the interest of our planters that they should ascertain, by direct experiment, the proper time of gathering the plant.

When the plant is gathered, it has to undergo a process by immersion in water, for the purpose of extracting its colouring matter. This operation is performed in two ways—by fermenting the green plant in a steeper, or by first drying the leaves and then simmering them in a boiler. The latter process is now pursued by some of the best makers in Bengal, and has apparently an advantage over the old process.

When the green plant is fermented in a steeper, and the process is carried a little too far, the colouring matter will become dark, and is said to be burnt—if carried a slight degree farther, it will be black, and of course the indigo will be very much injured. Nine-tenths of the indigo made in the United States partakes more or less of this character, and has evidently been injured by an excessive fermentation. To observe a due degree of fermentation in the steeper is the most difficult point in the whole process of making indigo; for should not the fermentation be carried far enough, a considerable loss of colouring matter will be the result. It is necessary, therefore, to carry it on to a certain point, and to draw it off the instant it arrives at that point; and this can be known only by a skilful observer who has obtained his knowledge by practice.

There is no chemical operation so difficult to describe as that of fermentation, and I almost despair of making myself clearly understood by practical workmen in the following description of the steeping process.

Fermentation has been divided by chemists into four kinds, the panary, vinous, acetic and putrefactive. The kind of fermentation given in the indigo steeper is evidently of that kind called panary, or the first stage of fermentation. It is known to be the panary by

the large quantity of carbonic gas given out, which rising to the surface, floats on the top, covered with a thin pellicle of the liquid. The difficult point for the operator to distinguish, is when it arrives at that degree of fermentation, and begins to assume the acetic. The same difficulty occurs with the woollen blue dyer, and the losses so frequently complained of, by the vats being out of order, and often irrevocably lost, arise from the fermentation being permitted to proceed too far.

The following directions are given as a guide for those who may be engaged in the making of indigo. Whilst the plant is in steep, draw off a little of the water, and with a pen dipped in it make a few strokes on white paper. The first will probably be high coloured, in which case the indigo is not sufficiently fermented. This operation is to be repeated every quarter of an hour, until it loses its colour, when it will have arrived at its true point of fermentation.

Let a small hole be made in the steeper, six or eight inches from the bottom, exclusive of the opening or aperture, for drawing off the impregnated water. Let this hole be stopped with a plug, yet not so firmly but that a small stream may be permitted to ooze through it. After the plants have been steeped some hours, the fluid oozing out, will appear beautifully green, and at the lower edge of the cistern, from whence it drops into the battery, it will turn of a copperish colour. This copperish hue as the fermentation continues, will gradually ascend upwards to the plug, and when that circumstance is perceived, it is proper to stop the fermentation.

During the progress of this part of the business, particular attention should be paid to the smell of the liquor which weeps from the aperture, for should it discover any sourness, it will be necessary to let the fermenting liquor run immediately into the battery, and lime water of sufficient strength must be added, until it has lost its sourness. As it is running off it will appear green, mixed with a bright yellow or straw colour, but in the battery it will be of a beautiful green.

Another maker has given the following description of the fermenting process:

When the plant is gathered, a large quantity is put into a vat, and some wood laid above to prevent its rising above the water. The mass begins to ferment sooner or later, according to the warmth of the weather, and the maturity of the plant—sometimes in six or eight hours, and sometimes in not less than twenty. The liquor grows hot, throws up a plentiful froth, thickens by degrees, and acquires a blue colour inclining to a violet—at this time, without touching the herb, the liquor impregnated with the tincture is let out, by cocks in the bottom, into another vat placed for that purpose, so as to be commanded by the first.

The boiling process, for extracting the colour from the dry plant, was obtained from Mr. Dalrymple, who had for many years been an extensive indigo maker in Bengal. He says, "take an iron, brass, or copper boiler, fill it within three inches of the top with the plants, press down with stones, and cover the plants with water.

The liquor must be heated, not until it boils, but until it begins to blubber, or simmer. The water, by this time, will look greenish, then draw it off into a shallow vessel, or vat, and beat for one or two hours to incorporate oxygen with it. On taking some of the liquor in a white saucer, little particles will appear in it as big as a pin's head, and smaller, then stop beating and throw in a little lime water, upon which the indigo will precipitate to the bottom, and the supernatant water will look like brandy. The water has now to be drained off to a level with the top of the sediment, lay the sediment on a cloth to drain, and when stiff enough put it into moulds to dry."

The directions given by Mr. Dalrymple are evidently imperfect, for none are given for the fermentative process, and those who are in the least acquainted with the manufacture of indigo, must know, that the colouring matter cannot be developed unless the liquor has previously undergone a due degree of fermentation.

I have been recently informed, that many first rate makers of indigo in Bengal, condemn the process of obtaining it from the dried leaves, on the plea that the article obtained is no better, and is much less in quantity. If any of our planters should be disposed to try the dry process, it will be necessary to inform them, that should the leaves, between gathering and drying, be subject to fermentation, only a small portion of colouring matter will be obtained, and that the loss sustained will be as the degree of fermentation.

During the precipitation of the colouring feculæ, the coarsest particles, possessing the greatest specific gravity, subside first, constituting the lower strata of the pulp, and the lighter and finer particles subsiding the last, form the upper part. It is necessary that indigo makers should take advantage of this circumstance, by first taking off the upper layer, and moulding it by itself, and the lower part by itself. By this means they may obtain several qualities of indigo from one mass of pulp.

It appears from analysis made by Bergman, Quatremere, and other chemists, that indigo of good quality does not contain more than from 46 to 47 per cent. of colouring matter, and that the very best samples do not contain more than 48 per cent.

The following table will exhibit an analysis of indigo of a good quality, and of the menstruua in which the impurities are soluble.

Mucilaginous parts separable by water, - - - -	12
Resinous parts soluble in alcohol, - - - - - -	6
Earthy parts soluble in acetic acid, - - - - -	22
Oxide of iron soluble in muriatic acid, - - - - -	13
Colouring parts almost pure, - - - - - -	47
	100

There cannot be a doubt, that manufacturers of indigo might produce, by attending to the analysis made by chemists, an article far superior to any hitherto offered to the public. It will also appear certain, when experience shall have confirmed the value of a superior indigo, that a more than remunerating price could be obtained for a purer article. For certain purposes a pure indigo would command

double, and even treble prices, provided the supply were not too great for the consumption. This being the case, it would be well for our manufacturers to pay some attention to the subject, and endeavour, by some easy unexpensive process, to bring it to as great perfection as possible. To promote this subject, I offer the following extracts and observations.

Bergman dissolved, by means of ebullition in water, a ninth part of the weight of indigo.

Quatremere also separated, by means of water, the parts which are soluble. He states their quantity to be more considerable, the worse the quality of the indigo; and that, after this operation, the residuum has acquired the qualities of the finest indigo. He therefore proposes to purify what is of inferior quality, by boiling it in a bag, and renewing the water till it ceases to acquire colour.

If sulphuric acid be diluted with water, it attacks only the earthy matter that is blended with the indigo, and some mucilaginous ingredients.

Muriatic acid digested, or even boiled with indigo, takes up the earthy part, the iron, and a little extractive matter, which colours it yellowish brown, but without attacking in any manner the blue colour.

It is evident from the analysis, that to make indigo far superior to any now brought to market, requires only an application of known facts to the art of making it. It is a well ascertained fact, that if indigo be boiled in water containing muriatic acid, twenty-five per cent. of the impurities contained in the best samples would be extracted, and that the colouring matter remaining would form an indigo far superior to the best now offered for sale.

The best Bengal indigo, and I never remember it in a more depressed state, is worth, wholesale, one dollar eighty cents per pound. The average value of all the indigo imported from foreign countries is about one dollar and fifteen cents per pound, whilst the average value of that made in the United States is not more than fifty cents, and this great difference in the value is owing almost entirely to the great impurity of the article. The first object with our manufacturers, therefore, should be to make their indigo equal in quality to the best Bengal, and the second to go as far beyond them as is practicable.

In the best samples of the indigo of this country, there is evidently too much extractive matter, and there is no doubt that this defect arises, in a great measure, from their taking the pulp from the beater, instead of their running it into a vat of clear water, and after well agitating it there, letting it settle in the third vat. This third receiver should undoubtedly be added where it has not been already done. Those manufacturers who would wish to avoid the expense of a third receiver, may fill up the beater with fresh water, after drawing off the first liquor, and perform the operation in the same vat.

The greatest improvement I can at present suggest, would be to boil the pulp taken from the vat by steam heat, for fifteen or twenty minutes, in water containing as much muriatic acid as would give to

the liquor a strong acid taste. This operation can also be performed by placing a pipe in the beater from any steam vessel.

Muriatic acid, beside the oxide of iron, dissolves the carbonate of lime, red rosin, and alumina, contained in the indigo, and by being mixed with water, the greater portion of the extractive matter would be taken up at the same time. By boiling the pulp in water strongly impregnated with muriatic acid, the indigo remaining would be twenty-five per cent. better than any hitherto made, and a price, more than equivalent to the difference in the loss of weight and expense of working, would be obtained from the consumer.

I have been informed by some South Carolina planters, that owing to their inability to proceed with the fermentative operation as rapidly as the crops require, a portion is often left on the fields for two or three weeks after the plants have arrived at maturity. This circumstance alone is sufficient to blast the interest of the planters. Their interest would be much better consulted, by gathering in the crop, drying it, and extracting the colouring matter by the simmering process. This difficulty is obviated in Bengal by their planting the seed in successive periods, so that one crop shall ripen, a week or more after the other, each crop being sufficient to supply one set of tanks during the period of maturity.

Dyers, as well as indigo planters, would be highly benefitted by attending to the analysis of indigo. Were they, when a superior colour is wanted, to boil the ground indigo in a bag, as described by Quatremere, there would be no difficulty of obtaining the desired result from indigo of any quality. [*Silliman's Journal.*

On the use of Anthracite in Blacksmiths' Shops. *By* G. Jones, Tutor in Yale College.

In a recent visit to Mauch Chunk and the vallies of Wyoming and Lackawana, I was struck with the universal employment of anthracite in the blacksmiths' shops of those regions, and with the strong terms in which the workmen expressed their preference for it over every other kind of coal. To use their own words, "they would not substitute charcoal, if it were brought and offered them for nothing, at their doors." Though familiar with it in the grates of parlours, and in furnaces, on our sea-board, the present was a use to which I had not hitherto seen it applied. I gave the subject some attention, and as the results may be useful to the public, will endeavour to offer them.

The kind of coal to be employed.

Every one familiar with anthracite, in place, knows that its varieties, even in the same bed, are very great. Some of the strata are usually slaty, portions of others are charged with sulphuret of iron, (iron pyrites,) while other parts, generally far the greater portion, are almost entirely carbonaceous. The last is always preferred by the smiths, and the value of pure coal to them is so well known, that

in one mine, near Wilkesbarre,* which we visited, a stratum was reserved for them, the coal from which was sold for two dollars per ton, while for the remainder but half this price was demanded. As the proprietors of the different mines, however, are desirous of acquiring a good reputation for their coal, only the best is now sent to the sea-board, and it is probable that but a small portion of the anthracite in our markets is unfit for the heating of iron. The proper coal is easily distinguished: I seated myself by a heap of anthracite, near a smith's shop, in Wilkesbarre, and with a little assistance from the owner learned, in five minutes, to discriminate between the different kinds. The slaty coal is inferior in lustre, and an experienced eye will easily distinguish the delicate lines of the slate: its fracture is also even, while that of the pure anthracite is more or less conchoidal. The sulphuret of iron forms usually fine white specks, and may be easily observed from its contrast with the glossy jet of the coal. If any difficulty, however, is found in making the distinction before heating, there can be none when the coal is in the furnace. The slaty coal soon becomes covered with a white ashy coat, and has a dull appearance: the pyritous coal has a bright glow, but on being moved, will send up numberless brilliant sparks; its smell is also stronger, but the smiths rely more on the former circumstance than on the smell. The slaty coal will not injure the iron; its only evil is in the inferior degree of heat it affords. The case is different with the pyritous anthracite. Yellow iron pyrites is a bi-sulphuret: when heated, one proportional of its sulphur combines with the bar to be forged, making it a proto-sulphuret, and giving consequently a brittle character, which renders it difficult to be wrought. When in small quantities, however, neither the slaty nor the pyritous coal is to be dreaded: if the latter is in larger proportion, the smiths find an easy security from its influence, by throwing common salt upon the fire. Only a small quantity is needed: they simply scatter it upon the ignited coal and then work confidently, as in other cases: I was informed that it is uniformly effectual. Salt is sometimes used by them to assist in igniting the anthracite: I have observed, since my return, that it is also used as a guard against sulphur in bituminous coal.

The manner of constructing the furnace.

The general construction need not differ from that in other shops, the bellows and the hearth being the same. The tuyere-iron, (pronounced by the smiths as if spelt *tue*-iron,) however, must have a greater diameter: in the shops which I have examined, it varied from three-fourths of an inch to an inch; about seven-eighths of an inch, for the inside diameter, was usually considered the best. As there are no sparks or smoke, a chimney is not needed; and although one might be of service in carrying off the gases which arise from the coal, the shops at Wilkesbarre are usually constructed without any chimney, an opening in the gable end near the roof being found to

* The Baltimore mine.

answer the purpose nearly as well: even this is used only during the summer. In visiting these shops, a person is struck with the cleanly appearance of the workmen, the dust from anthracite, though penetrating, not being of a character to soil either furniture or clothes: I frequently heard the workmen speak boastingly of the fact that they could now be as clean and comfortable as persons engaged in any other trade.

The manner of using the coal.

Charcoal or dry wood is requisite for igniting the anthracite; when fairly ignited, it will need no foreign help, provided the iron to be heated is small, and is to be operated upon to no great extent at one time. If the bar is large and requires a diffused heat, a small quantity of charcoal must be mingled with the anthracite, as without this, the bellows are not able to ignite a large quantity of the mineral coal. The iron to be heated should not be thrust down so near the tuyere-iron as is the case when charcoal is employed. Most of the failures, at the first use of anthracite, I was informed, arise from ignorance of this circumstance, from having the diameter of the tuyere-iron too small, and from leaving the iron too long upon the fire. Anthracite will heat a bar in one half the time that is requisite for charcoal, and until the blacksmith is familiar with its use, the heating process must be closely observed, or the iron will be burnt, before he thinks that it has been sufficiently heated. The bar may easily be watched, as from its being so far above the tuyere-iron, the quantity of coal above it is smaller than in the charcoal furnace, and it may be kept constantly in sight. While in the fire, it should be suffered to remain undisturbed; if moved about, as is common in the charcoal fire, the heating will be retarded.

Advantages of the anthracite coal.

Some of these may be inferred from the preceding remarks. They consist chiefly in the saving of time and of money. From the rapidity with which the iron is heated, the quantity of work done is about one-third greater than when charcoal is employed. The gain, as respects the cost of materials, will depend on the price of anthracite, which from its weight, increases rapidly in value as we recede from the mines. The Carbondale Company state that they will be able to offer it in the New York market, the coming season, for $6 50 per ton; and the time will soon arrive, when from the increased facilities for transportation from the various coal regions and from the rivalry of the different companies, this fuel may be had at a price far less. At its present cost, however, even at remote places, it is much cheaper than charcoal. A ton of anthracite will heat as much iron as two hundred bushels of the latter, which at the average price of seven or eight dollars per hundred bushels, will give a saving of about one half in favour of the anthracite. I visited a shop sixty-five miles from Mauch Chunk, from which mine the owner was in the habit of bringing his coal in wagons: he said it cost him ten

dollars per ton, delivered at his door, but that even at this price it produced a saving of 30 per cent. in his material, and he seldom employed any other coal. The use of it has extended to a considerable distance, in all directions from the coal region, and is now increasing rapidly in Philadelphia: in a few years, it will probably be general throughout the country. The first effort at employing it, will generally be attended by difficulties: sometimes the smith fails entirely, and throws it by in disgust; but I believe I have not heard of one case, in which a fair trial has been made, that has not resulted in a great fondness for this species of coal. Still, however, its best friends acknowledge that for some purposes it is not well adapted. When a *hollow heat* is requisite, it will not answer; nor will it suit in forges where the fire must be greatly disturbed by the removal and replacement of the bar. It is said also not to be good for *tempering*, but I have seen it employed for this, and in Mons. Brard's *Minéralogie appliquée aux arts*, I observe it is spoken of as highly useful in the manufacture of a variety of delicate edge tools.

[*Ib.*

Report on Fulminating Powders capable of being used as priming for Fire-arms. *By* Messrs. Aubert, Pelissier, *and* Gay-Lussac.

[From Annales de Chimie, xlii. September 5, 1829.]

[Concluded from page 133.]

The strength of fulminate of mercury is much greater than that of the best gunpowder, but it would be difficult to say how much.* To estimate it, various quantities of fulminate of mercury and gunpowder have been exploded under a hollow mass of copper, placed so that its ascent might be measured. It has been found, in this circumstance, that the fulminate raised the mass of copper to a height from fifteen to twenty times greater than the powder.

The great rapidity of the explosion of mercurial fulminating powder, from which effects result similar to those produced by a missile thrown from a fire-arm, might render its employment useful in some circumstances, for instance, for breaking gates under the form of petards.

Mixture of fulminate of mercury with powder for making priming.

The quantity of fulminate of mercury necessary for a priming (*une amorce*) is so small, that it is in a manner unmanageable. One has been naturally led to mix it with common powder, to increase the bulk of the priming; but this is not the chief advantage of the mixture. Indeed, pure fulminate of mercury communicates inflamma-

* The French marine has adopted a priming made with the same powder, which is placed on the touch-hole of the cannon, and which not only carries the fire to the charge, through the whole thickness of the metal, but also cracks the cartridge, however strong may be the parchment or material of which it is made.

tion to powder but with difficulty, and at much smaller distances than when it is mixed with bruised or very fine powder: this is a consequence of the instantaneousness of its inflammation. If it is alone, the elastic fluids have lost the greater part of the caloric before reaching the powder, and can no longer inflame it; but, if it is mixed with very fine powder, the latter is carried to the powder while in a state of ignition, and sets fire to it.

In the trials of mixtures of the fulminate with various substances, made rather with a view to preserve the priming from humidity than to change the composition of the powder, it was found that many were unfavourable to the explosion of the fulminate, although mixed with it only in very small proportions; such are oil, tallow, and rosin.

The most advantageous proportions for caps is ten parts by weight, of fulminate, and six parts of bruised powder. They are rendered a little less quick with ten of fulminate and seven of fine powder.

In waxed primings, the bruised powder should be in less proportion. It amounts to five parts in those of commerce, and is 3.3 in the priming proposed by M. Vergnaud for muskets.

The quantity of fulminate of mercury sufficient for a fowling piece is 0.0166 grammes = $\frac{1}{4}$ gr. Eng. or 57600 primings may be made with one kilogramme (= 2.2 lbs. avoirdupois) of the fulminate; but, for muskets, the priming should be a little augmented. In the waxed primings the quantity of fulminate is 3 centigrammes (= 0.46 grain E.) or nearly double that of the priming caps.

The force necessary for producing inflammation of the fulminate of mercury increases as the proportion of bruised powder becomes greater, and the layer of the fulminate thicker. Consequently primings may be made more or less explosive, which should inflame, for example, by the blow of the hammer falling from the whole cock, and not when falling from the half cock. A ram falling from different heights has been used with advantage for measuring this force; but the necessity has been discovered of seeking at the same time the extent of the propagation of the inflamed jet in the passage leading to the powder; for, as it has been remarked, it is not the pure fulminate which carries inflammation the furthest. Besides, the most explosive primings may be employed, without fear of inflaming them by the fall of the hammer from the half cock, on leaving between it and the passage, or touch-hole, but a very small distance.

Examination of fulminating primings with regard to foulness, and to their action upon iron.

Fulminating mercury, as already remarked, leaves a carbonaceous residue on the bodies on which it has been detonised. This residue is very considerable relatively to the weight of the fulminate; but it is followed by no inconvenience by reason of the extreme smallness of the fulminating primings. Besides, it never acquires coherency, and cannot accumulate much without being dispersed by the effect of the detonation. It exerts moreover no corrosive action on iron.

Fulminating primings, such as are used, and which are a mixture of fulminating mercury and bruised gunpowder, act in a different

manner. If the foulness which they leave be judged of by the number of times of missing fire, a very accurate way of appreciating the inconveniences, we should regard it as null; for, by experiments which will be stated hereafter, in a hundred successive shots, there was not one instance of a miss fire, neither in the touch hole nor the barrel, whilst with common powder and our old locks the times of missing fire are commonly reckoned as one in seven shots.

To appreciate the corrosive action of the fulminating priming, nearly equal quantities of pure fulminate of mercury mixed with bruised powder for priming, and of chlorate of potash mixed with common powder, were detonised in a well polished gun barrel. A portion of the barrel was also moistened with a solution of marine salt, and the barrel was laid in a damp place on the ground floor. Twenty-four hours afterward, the effect produced on the iron was examined. The pure fulminate had left a carbonaceous residue which appeared more bulky than that of common powder, but underneath it the iron was unaltered. Common powder gave less residue, and had less rusted the iron than the fulminating powder for priming: after this it was the salt water, and, lastly, the chlorate powder, which produced the most rust.

Examination of the advantages of percussion guns, with respect to the economy of powder.

In the common gun, there is a loss of elastic fluids by the touch-hole, which does not occur with percussion guns, and it has appeared interesting to measure the extent of this loss.

Two similar guns were taken of the pattern of 1816, for the infantry, which we shall designate as No. 1 and No. 2, and they were tried in succession by the pendulum, with a charge of 10 grammes (= 154.34 grains, E.) of musket powder and a ball of 19 to the pound, placed between two smooth pieces of card as wadding. The recoil being found to be the same for both guns, a percussion lock was fitted to No. 2, and the quantity of powder which was required as a charge was sought for to obtain the same recoil as with the other gun loaded with 10 grammes of powder and a ball. It was found that 9.14 gr. (= 141.1 grains) were sufficient, and, consequently, the charge might be diminished nearly one-tenth, by substituting the percussion for the common gun, without lessening the distance to which it would carry. The ratio just stated, remains exactly the same, on employing charges a little exceeding 10 grammes, and applies exactly to the charge of 12.25 gram. (= 189.1 grains) of military fusils, whereof about 11 grammes only enter the barrel.*

To the economy of powder of about one-tenth of the charge produced by the adoption of the percussion gun, must be added that of the priming in the common gun, the weight of which when the pan is filled, is, at a mean, about 1.1 gramme (= 17 grains nearly,) and last that due to missing fire, or flash in the pan only, commonly

* The difference between the effects of percussion guns and those with flints, is perhaps also due in part to the greater rapidity of the inflammation of the charge occasioned by the priming of fulminating powder.

estimated at one in seven shots. By uniting these different quantities, we find 2.276 (= 35 grains) of saving for every shot of 12.25 grammes (= 189 grains,) or 2.276 kilogrammes (= 5 lbs. avoird.) in 1000 shots, or lastly, 6.26 francs, at 2.75 francs per kilogramme of powder. Indeed, this advantage is partly compensated by the price of the fulminating priming, which may be estimated, for caps, at 3.50 francs the thousand; but, on subtracting this last number from 6.26 francs, we still obtain a saving of 2.76 francs in 1000 discharges. Furthermore we insist on this calculation only to show that the adoption of fulminating primings would be, with regard to economy, more advantageous than onerous.

Missing fire in percussion guns.

In order the better to appreciate the effect of fulminating primings, we have endeavoured to place ourselves in circumstances similar to those which occur in war, by employing for the experiments, a musket powder a little altered, and badly dusted (epoussétée.) The gun was fired with ball, with the accustomed charge, and with fulminating caps.

With a chimney of which the diameter was 1.1 millimetre (= 0.04 inch,) the barrel began to miss fire at the 53d shot, and from the 53d to the 60th, six primings were used without clearing the touch-hole before it went off.

By substituting a chimney of 1.85 millimetre (= 0.073 inch) in place of the former, there was no miss fire in 100 shots, in several series of experiments. After the last series, the gun was not cleaned, and the next morning the shooting was recommenced. Missing fire occurred at the following shots: 1, 2, 3, 4, 5, 6, 7, 16, 42; but afterwards the series of shots up to 100, was terminated without missing fire. It was evidently the foulness of the chimney formed the preceding evening, expanded by the damp which it had absorbed, which occasioned the missing fire. It is remarkable that, in all these experiments, the primings did not once fail to explode.

The same trials were recommenced with the waxed primings proposed by M. Vergnaud, using the same gun, its lock having been suitably modified. The temperature of the atmosphere being very high, led to the discovery of several inconveniences of the waxed primings; they became soft, stuck together by a slight pressure, and lost their form. While the temperature was high, the number of times of missing fire, with the chimney of 1.1 millimetre, was greater than with caps: the failures often began with the 20th shot, but did not become continuous, as with caps, till towards the 60th. With a touch-hole 1.85 *m.* (= 0.073 inch) in diameter, there was not one failure in 100 shots; but the foulness then became so considerable it was necessary to use a shade for the sight (couvre-vue.) The priming sometimes failed to explode, which might depend as much on its peculiar nature as on the form of the gun lock.

This is not the place for comparing the lock for waxed primings to that for caps: we shall confine ourselves to remarking, that the lock for caps requires less precision in its execution than the other;

that its hammer will more certainly strike the chimney in a perpendicular direction, and will require less force for inflaming the priming; and, lastly, the foulness will be considerably less.

The advantage of having no miss fire is not confined to an economy of powder of one priming in seven: it must be considered that the quantity of powder employed by the soldier, whether involuntarily, or designedly, as he often does to diminish the recoil of his piece, is much more considerable than that which has been supposed. But, independently of that saving which may appear insignificant, the absence of every failure to discharge the piece has the immeasurable advantage of augmenting the assurance of the soldier, by giving him the certainty that his piece will not fail him in face of the enemy at the moment of danger.

It might be thought that we could not succeed in preventing the missing fire but by giving the chimney of the touch-hole too great a diameter, and consequently by diminishing the distance to which the piece would carry; but experiment has taught us, that the recoil of the pendulum fusil is exactly the same with a chimney 1.85 mill. in diameter, as with a chimney 1.10 mill. in diameter. This result will not surprise, if it be considered that the chimney remains closed up by the hammer after the percussion. It would be even possible to enlarge the diameter still more, on giving the hammer a force sufficient to resist the effort of the elastic fluids which tend to escape through the touch-hole.

Further, we have convinced ourselves that, even in a common gun, the variation of the diameter of the touch-hole, within the limits from one to two millimetres, occasions no perceptible diminution of the distance to which it will carry. The following is a table of the results which we have obtained.

Diameter of the touch-hole.	Charge of powder corresponding to each diameter for obtaining the same recoil by the pendulum fusil.
0.90 millim. = 0.035 in.	10.00 grammes = 154.34 grs. Eng.
1.66 ..... = 0.065	10.00 ..... = 154.34
2.76 ..... = 0.108	10.39 ..... = 160.36
3.48 ..... = 0.137	10.72 ..... = 165.45

Manufacture of the fulminate of mercury.

This powder is prepared with mercury, nitric acid at 38° or 40° of Baumé, (= 1.36 to 1.36 s. g.) and alcohol at 85 or 88 centesimal degrees. Varied experiments on small quantities have taught us that the best proportions are those found by Howard: 1 mercury, 12 nitric acid, and 11 alcohol. One kilogramme of mercury (= 2.2 lbs. avoird.) produces 1¼ kilogramme of pure fulminate, a quantity with which at least 40,000 primings in caps may be made for the military fusil.

The fulminate of mercury, as it is prepared, being in small crystals, are to be first ground on a marble table with a wooden mullar

after having wetted it with 30 per cent. of water. Afterward, add six parts of common powder to ten parts of fulminate, and continue the grinding. A firm paste is obtained, which dried to the proper degree by exposure to the air, is made into grains, each of which is to form one priming.

If the fulminate of mercury offers no danger as long as it is moist, it is no longer the case when it is dry, and should not then be handled without great caution. Nevertheless we may avoid employing it in that state; and as the manufacture of fulminating priming will be always very small, and as it may be very much divided, and very perfect methods of proceeding applied to it, we do not hesitate to declare that it might be made without any difficulty and without more danger than that of common powder in the government establishments. An explosion would have even less injurious consequences, as well to the workmen as the buildings, on account of the very small quantity of matter under manipulation.

Different sorts of priming hitherto employed.

There have been used, 1st, the fulminating powder in grains; 2nd, the powder in pastilles covered with lead or paper; 3d, the powder in grains varnished; 4th, the waxed primings; 5th, the caps or capsules; and 6th, tube primings.

The powder in grains is very dangerous, for the explosion of a single grain produces that of the whole mass. It is almost entirely disused. The other primings have not the same inconvenience; but as they have it in common to have a covering, and as those called waxed, and with caps, are almost the only ones in use, we shall occupy ourselves with the latter only.

The waxed primings were in use with sportsmen, when proposed by M. Vergnaud for the infantry. Every one contains three centigrammes (nearly half a grain Eng.) of fulminate of mercury, and one centigramme of bruised gun powder, and are enveloped with a coating of wax applied by hand, which defends them very well from the action of moisture, and prevents them from exploding simultaneously. They fix also very readily to the pan, and may be easily carried, and without danger, by always taking care to protect them from the heat of the sun, and that of other bodies which might produce their agglomeration.

They have the inconvenience of causing great foulness, and giving a little more smoke and smell than cap primings. Their present price in commerce is from 6.75 to 7 francs per thousand.

The cap primings are most in use at present, and form at least 99 per cent. of the consumption: those for the guns of sportsmen contain in each priming 0.017 grammes of fulminate of mercury, mixed with six-tenths of its weight of bruised gunpowder (*pulverin.*) These primings very well resist the action of humidity, and take fire after several hours immersion in water. Their very regular and solid form allows of their being fixed on the chimney of the touch-hole by mechanical means, which will be very advantageous for military fusils. In the explosion, the copper cap is torn, and rarely

divided and projected; but, by hollowing the head of the percussion hammer, the copper is no longer projected excepting towards the ground.

The copper caps are made by means of a fly press with great rapidity. The primings sometimes take fire during their manufacture; but the inflammation but very rarely communicates to the small number of those under manipulation. They are easily carried and without danger. Their present price in commerce is $3\frac{1}{2}$ francs per thousand. At this moment, we cannot say which sort of priming, the waxed or the cap priming, would be preferable for military service. Experiments will be necessary to resolve the question.

Conclusion.

The experience acquired respecting fulminating primings, and their almost general use for the guns of sportsmen, render their advantage in war incontestable. Their adoption would save powder, render the discharge certain, and give the soldier more confidence.

The chlorate of potash powder having the inconvenience of rusting and making the arms very foul, and of occasioning in consequence the piece to miss fire, the primings with fulminate of mercury should be preferred, having none of those inconveniences.

The manufacture of fulminate of mercury, although not without danger, offers no real difficulties, and the administration of powders would speedily be prepared to undertake it, and to supply all the wants of government.

The primings proposed by M. Vergnaud, are composed of fulminate of mercury, like those already in use; but they are characterized by their covering of wax. Those in caps, judging from the almost general use of them for fowling pieces, appear to be preferable, but the wants of the military service may require other conditions which it does not belong to us to examine, and experience alone should determine the preference.

In terminating this report, we think it right to anticipate an objection which might be raised against the application of fulminating primings to fire-arms used in war, namely, that the mercury forming the essential basis of these powders comes to us from foreign countries, and in case of war, we might be deprived of it, so as seriously to compromit the military service.

But to reduce this objection to its just value, it is sufficient to remark, that at least 40,000 primings can be made with one kilogramme of mercury, and that with 100 kilogrammes four millions of primings might be made, a sufficient quantity for 100,000 men. It would therefore be easy to provide at a favourable time a sufficiency of mercury for the military service; besides, we know by experience, that even during the last continental blockade, France was never in want of mercury. Lastly, we might, in case of need, substitute for a short time the chlorate of potash for fulminate of mercury, without making any change in the locks of the fire-arms, or might employ even fulminate of silver.

Observations on Writing Ink. By J. Bostock, M. D., F. R. S.

[From the Transactions of the Society of Arts.]

When the sulphate of iron and the infusion of galls are added together, for the purpose of forming ink, we may presume that the metallic salt or oxide enters into combination with at least four proximate vegetable principles:—gallic acid, tan, mucilage, and extractive matter; all of which appear to enter into the composition of the soluble part of the gall nut. It has been generally supposed, that two of these, the gallic acid and the tan, are more especially necessary to the constitution of ink; and hence it is considered, by our best systematic writers, to be essentially a tanno-galate of iron. It has also been supposed, that the peroxide of iron alone possesses the property of forming the black compound which constitutes ink, and that the substance of ink is rather mechanically suspended in the fluid than dissolved in it.

Ink, as it is usually prepared, is disposed to undergo certain changes, which considerably impair its value; of these the three following are the most important: its tendency to moulding; the liability of the black matter to separate from the fluid, the ink then becoming what is termed ropy; and its loss of colour, the black first changing to brown, and at length almost entirely disappearing.

Besides these, there are objects of minor importance to be attended to in the formation of ink. Its consistence should be such as to enable it to flow easily from the pen, without, on the one hand, its being so liquid as to blur the paper, or, on the other, so adhesive as to clog the pen, and to be long in drying. The shade of colour is not to be disregarded; a black, approaching to blue, is more agreeable to the eye than a browner ink; and a degree of lustre or glossiness, if compatible with the due consistence of the fluid, tends to render the characters more legible and beautiful.

With respect to the chemical constitution of ink, I may remark, that although, as usually prepared, it is a combination of the metallic salt or oxide with all the four vegetable principles mentioned above, yet I am induced to believe, that the last three of them, so far from being essential, are the principal cause of the difficulty which we meet with in the formation of a perfect and durable ink. I endeavoured to prove this point by a series of experiments, of which the following is a brief abstract: having prepared a cold infusion of galls, I allowed a portion of it to remain exposed to the atmosphere, in a shallow capsule, until it was covered with a thick stratum of mould; the mould was removed by filtration, and the proper proportion of sulphate of iron being added to the clear fluid, a compound was formed of a deep black colour, which showed no farther tendency to mould, and which remained for a long time without experiencing any further alteration.

Another portion of the same infusion of galls had a solution of isinglass added to it, until it no longer produced a precipitate; by

employing the sulphate of iron, a black compound was produced, which, although paler than that formed from the entire fluid, appeared to be a perfect and durable ink. Lastly, a portion of the infusion of galls was kept for some time at the boiling temperature, by which means a part of its contents became insoluble; this was removed by filtration, when, by the addition of the sulphate of iron, a very perfect and durable ink was produced. In the above three processes, I conceive that a considerable part of the mucilage, the tan, and the extract, were respectively removed from the infusion, while the greatest part of the gallic acid would be left in solution.

The three causes of deterioration in ink, the moulding, the precipitation of the black matter, and the loss of colour, as they are distinct operations, so we may presume that they depend on the operation of different proximate principles. It is probable that the moulding more particularly depends on the mucilage, and the precipitation on the extract, from the property which extractive matter possesses of forming insoluble compounds with metallic oxides. As to the operation of the tan, from its affinity for metallic salts, we may conjecture, that, in the first instance, it forms a triple compound with the gallic acid and the iron, and that, in consequence of the decomposition of the tan, this compound is afterwards destroyed. Owing to the difficulty, if not impossibility, of entirely depriving the infusion of galls of any one of its ingredients, without, in some degree, affecting the others, I was not able to obtain any results which can be regarded as decisive; but the general result of my experiments favours the above opinion, and leads me to conclude, that, in proportion as ink consists merely of the gallate of iron, it is less liable to decomposition, or to experience any kind of change.

The experiments to which I have alluded above, consisted in forming a standard infusion, by macerating the powder of galls in five times its weight of water, and comparing this with other infusions which had either been suffered to mould, from which the tan had been abstracted by jelly, or which had been kept for some time at the boiling temperature, and by adding to each of these respectively both the recent solution of the sulphate of iron, and a solution which had been exposed for some time to the atmosphere. The nature of the black compound produced was examined by putting portions of it into cylindrical jars, and observing the changes which they experienced, with respect either to the formation of mould, the deposition of their contents, or any change of colour. The fluids were also compared by dropping portions of them upon white tissue-paper, in which way both their colour and their consistence might be minutely ascertained. A third method was, to add together the respective infusions and the solutions of the sulphate of iron in a very diluted state, by which I was enabled to form a more correct comparison of the quantity and of the shade of the colouring matter, and of the degree of its solubility.

The practical conclusions that I think myself warranted in drawing from these experiments are as follow:—in order to procure an ink which may be little disposed either to mould or to deposit its

contents, and which, at the same time, may possess a deep black colour not liable to fade, the galls should be macerated for some hours in hot water, and the fluid filtered; it should then be exposed for about fourteen days to a warm atmosphere, when any mould which may have been produced must be removed. A solution of sulphate of iron is to be employed which has been exposed for some time to the atmosphere, and which consequently contains a certain quantity of the red oxide of iron diffused through it. I should recommend the infusion of galls to be made of considerably greater strength than is generally directed, and I believe that an ink formed in this manner will not necessarily require the addition of mucilaginous substance to render it of a proper consistence.

I have only to add further, that one of the best substances for diluting ink, if it be, in the first instance, too thick for use, or afterwards become so by evaporation, is a strong decoction of coffee, which appears in no respect to promote the decomposition of the ink, while it improves its colour, and gives it an additional lustre.

Method of Condensing Brass. *By* Mr. CORNELIUS VARLEY.

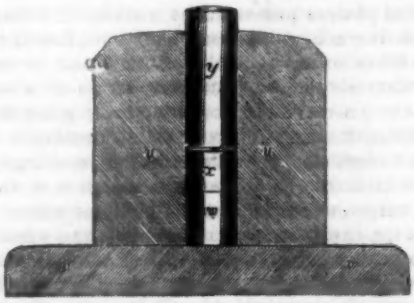
[From the Transactions of the Society of Arts.]

SIR,—About thirty-five years ago, a very costly chronometer was put into the hands of my late uncle, Mr. Samuel Varley. It was apparently without fault, but had baffled the efforts of some of the best workmen in the trade to make it keep time. My uncle discovered the cause of this imperfection to arise from the balance being magnetic; he accordingly replaced it with one of well hammered gold, and the watch was soon made to keep good time. He was ever afterwards accustomed to employ gold or brass as the material for the balance of all important watches, making the brass himself in order to secure its purity, and hammering both it and the gold in the tool about to be described. He also made escapement wheels of brass thus hammered, and was frequently applied to by others in the trade for brass of his making and preparing, it being found that such would bear cutting finer and sharper than any other, without failing; for (to use the somewhat quaint but expressive phrase of the workmen,) his brass exhibited in the lathe a certain sweetness and pleasantness, evidently the result of superior homogenity.

If a piece of malleable metal be successively struck on two opposite sides by a hammer, the face of which is larger than the metal, this latter soon spreads out and cracks at the edge. If, on the contrary, the face of the metal is larger than that of the hammer, and the blows be given as nearly as may be, on the centre of the plate, the part struck, being surrounded by a hoop of metal, as it were, can scarcely spread laterally, and is soon hardened by condensation: but the neighbouring parts, in proportion as they approach the margin of the plate, not being sufficiently restrained from spreading under the hammer, cannot be hardened in the same degree with the middle portion: besides, every blow, while hardening the part im-

mediately under it, is, in consequence of the inequality of resistance, producing a contrary action on the adjacent parts, by violently straining and stretching them. If the metal be in the form of a block, and be hammered on all sides, a tolerably uniform mass may be obtained; but this uniformity is only a balance of opposite states all through the mass, it being impossible to condense the block by hammering in one part, without forcibly straining the neighbouring parts. Such hammering, therefore, is limited; for although a certain quantity hardens the metal, every blow beyond this increases its unsoundness, till at last the block is good for nothing, and can only be cured by melting or welding it afresh.

The tool (shown in the annexed cut,) obviates all these inconveniences. *u, u,* is the section of a block of hard steel, made perfectly flat at bottom, where it rests on the face of the anvil, *v, v;* a hole, about one-fourth of the diameter of the block, is bored through its axis truly vertical; *w* is a short cylinder of hard steel dropped into the hole in the block, which accurately fits, and resting on the anvil; *x* is the piece of brass or other metal to be hardened: it must be turned quite clean and smooth, so as to fit the hole with perfect accuracy, and must be made quite flat both at bottom and at top; *y* is a punch of hard steel, with a somewhat convex top. The pieces being put together, the top of the punch *y* is to be struck with a moderately heavy hammer, gently at first, and increasing gradually to the utmost effect; this must then be changed for the largest hammer that the block and punches can safely bear. The momentum of the blows will be communicated to the disk *x;* and as both this and the punches are made accurately to fit the hole in the block, it is evident that the only effect of the blows can be the condensation of the disk *x*.



At the commencement of the hammering, a remarkable difference, both in the sound and in the feel of the hammer in the hand, will be perceived between striking on the punch and on the anvil: as the work proceeds, this difference becomes less; and when the difference has ceased, that is, when the hammer rebounds from the top of the punch as much as it would do from the anvil, the metal has acquired its greatest degree of hardening by compression. A large

hammer, with moderate speed, appears to communicate its effect deeper into a block of metal than a lighter one moving as much quicker as it is lighter; for the metal springs to a quick blow, for want of time to allow the particles permanently to recede; a heavy blow, on the contrary, being slower than the vibrations of the metal, overrules them, and sends the effect deeper into its substance. The shorter the punch, the more efficiently does it communicate the impulse of the hammer: the length, therefore, of the hole in the block above the metal should not be more than sufficient to form a secure guide to the punch, and the upper unsupported part of the punch should be as short as it can conveniently be made. The block, as well as the upper and the lower punch, should be hardened and then tempered to a straw colour, to enable them to bear the long continued action of the hammer.

The disk of the metal is got out by withdrawing the upper punch, and then placing the block over a hole larger than its own; a long punch being then put in, a few blows of the hammer will force out the short punch and the condensed metal.

Account of the CHEVALIER ALDINI'S *Apparatus for the preservation of persons exposed to flames.*

THE Chevalier Aldini, of Bologna, has been earnestly occupied in the construction of an apparatus, or rather clothing, intended to preserve persons from injury who are exposed to flames, which has become the subject of some of the *Conversazioni* at the Royal Institution. The following description of its composition and effects, in the words of Professor Farraday, will convey a just idea of its properties as well as of its application:—

A union of the powers possessed by a metallic tissue to intercept flame, with the incombustible and badly conducting properties of amianthus, or other substances, has been made in the apparatus; and the latter consists of two distinct systems of clothing, the one near the body composed of the badly conducting incombustible matter, and the other, or external envelope, of a metallic tissue.

The pieces of clothing for the body, arms, and legs, are made of strong cloth which has been soaked in a solution of alum; those for the head, the hands, and the feet, of cloth of asbestos. That for the head is a large cap, which entirely covers the whole of the neck, and has apertures in it for the eyes, nose, and mouth, these being guarded by a very fine copper wire gauze. The stockings and cap are single, but the gloves are double, for the purpose of giving power of handling inflamed or incandescent bodies.

M. Aldini has, by perseverance, been able to spin and weave asbestos without previously mixing it with other fibrous substances; the action of steam is essential in the bending and twisting of it, otherwise the fibres break. The cloths prepared with it were not of close texture, but loose: the threads were about one-fiftieth of an inch in diameter, and of considerable strength: cords of any size or

strength may be prepared from them. M. Aldini hopes to be able so to prepare other fibrous matters, as to be able to dispense altogether with this rare and costly material.

The metallic defence consists of five principal pieces; a casque, or cap complete, with a mask: this is of such size as to allow of sufficient space between it and the asbestos cap, and is guarded before the face by a visor, so that the protection is doubled in that part; a cuirass, with its brassets; a piece of armour for the waist and thighs; a pair of boots of double wire gauze; and an oval shield, five feet long, and two and a half wide, formed by extending gauze over a thin frame of iron. The metallic gauze is of iron, and the intervals between the threads about one twenty-fifth of an inch each.

When at Geneva, M. Aldini instructed the firemen in the defensive power of his arrangements, and then practised them before he made the public experiments. He showed them that a finger enveloped first in asbestos, and then in a double case of wire gauze, might be held in the flame of a spirit lamp or candle for a long time, before inconvenient heat was felt; and then clothing them, gradually accustomed them to the fiercest flames.

The following are some of the public trials made. A fireman having his hand inclosed in a double asbestos glove, and guarded in the palm by a piece of asbestos cloth, laid hold of a large piece of red hot iron, carried it slowly to the distance of 150 feet, then set straw on fire by it, and immediately brought it back to the furnace. The hand was not at all injured in the experiment.

The second experiment related to the defence of the head, the eyes, and the lungs. The firemen put on only the asbestos and wire gauze cap, and the cuirass, and held the shield before his breast. A fire of shavings was then lighted, and sustained in a very large raised chafing-dish, and the fireman approaching it, plunged his head into the middle of the flames, with his face towards the fuel, and in that way went several times round the chafing-dish, and for a period above a minute in duration. The experiment was made several times, and those who made it said they suffered no oppression or inconvenience in the act of respiration.

The third experiment was with the complete apparatus. Two rows of faggots, mingled with straw, were arranged vertically against bars of iron, so as to form a passage between thirty feet long, and six feet wide. Four such arrangements were made, differing in the proportion of wood and straw, and one was with straw alone. Fire was then applied to one of these double piles, and a fireman, invested in the defensive clothing, and guarded by the shield, entered between the double edge of flames, and traversed the alley several times. The flames rose ten feet in height, and joined over his head. Each passage was made slowly, and occupied from twelve to fifteen seconds; they were repeated six or eight times, and even oftener, in succession, and the firemen were exposed to the almost constant action of the flames for the period of a minute and a half, or two minutes, and even more.

When the course was made between the double range of faggots without straw, the fireman carried a kind of pannier on his back,

prepared in such a way as to be fire proof, in which was placed a child, with its head covered by an asbestos bonnet, and additionally protected by the wire gauze shield.

Four firemen made these experiments, and they agreed in saying, that they felt no difficulty in respiring. A very abundant perspiration came on in consequence of the high temperance to which they had been exposed, but no lesion of the skin took place except in one instance, where the man had neglected to secure his neck by fastening the asbestos mask to the body dress.

No one present could resist the striking evidence of defence afforded when they saw the armed man traversing the undulating flames, frequently hidden altogether from view by them as they gathered around him.

The fact that in M. Aldini's apparatus a man may respire in the middle of the flames is very remarkable. It has often been proved, by anatomical examination, that in cases of fire many persons have died altogether from lesions of the organs of respiration. It would appear that the triple metallic tissue takes so much of the caloric from the air as it passes to the lungs, as to render its temperature supportable; and it is known, by experiments in furnaces, that a man can respire air at 120 or 130° C. (= 246 or 267° F.) and even higher. Perhaps also the lesions referred to may have been due to aqueous vapour, which is often produced in great abundance in fires where endeavours are made to extinguish them by water, for such vapour would transfer far more heat to the lungs than mere air. Hence in every case, and however guarded, firemen should enter houses in flames with great prudence, because the circumstances are not the same as in the experiments just described.

It is remarked that several suits of this defensive clothing should be provided, not to clothe many persons at once, but that, in endeavouring to save persons or valuable things in cases of fire, the fireman should not approach again and again in heated clothing, but have a change at hand. The grand duke of Tuscany has ordered six suits for the city of Florence.

M. Aldini showed several experiments relative to the extinguishing power of his preparations before the Société de Physique de Genève. One consisted in placing an asbestos cloth of loose texture over a flame either of wax or alcohol; the flame was intercepted as well as it could have been by a piece of wire gauze. This experiment is supposed to favour the objections made to sir H. Davy's explication of the theory of the wire gauze safety lamp; but there seems to be a mistake in the idea which has been taken of that theory. Sir H. Davy never explained the effect of his lamp by absorption of heat from flame dependant upon the good conducting power of the tissue alone, but by the joint action of absorption and radiation. There is no doubt that cloth of asbestos is an admirable radiator, and that this power, with its conduction, is probably sufficient to explain the effects upon sir H. Davy's theory.*

[*Rep. Pat. Inven.*

* It has been reported in some of the public journals, that it is in contemplation to supply the new police of the metropolis with this fire proof clothing.

Partial opening of the Liverpool and Manchester Rail-way.

[From the Manchester Mercury.]

In consequence of its having been announced, for a week or two in the newspapers, that the directors of the Liverpool and Manchester Rail-way intended, on Monday last, to proceed in a carriage, propelled by a locomotive engine, from Liverpool along the whole length of the line, to hold their first Board in Manchester, a great concourse of people assembled. At five minutes past eleven the directors and some of their friends, with the resident engineers, in all about forty, arrived in two carriages. The engine used on the occasion was a new one, constructed by Messrs. Stephenson, and designated the Arrow. In addition to its own weight, with its appendages for the supply of water, &c. 7 tons, it drew behind it seven wagons, laden with stones, weighing 27 tons, behind these were stationed two coaches, containing the directors and their friends, weighing 5 tons more; making a total weight of 39 tons. With this weight the engine compassed the distance (rather more than thirty miles) *in two hours and one minute*, exclusive of 19 minutes taken up in stoppages for the necessary supply of fuel and water.

[From the Liverpool Mercury.]

The directors (on their return to Liverpool) filled with their friends two coaches, which darted through the dense mass of individuals who thronged the rail-way, passed over Chat Moss at the rate of about 22 miles an hour, and arrived at Edgehill, Liverpool, (after deducting seven minutes for stoppages) *in one hour and thirty minutes.* The average speed on the return from Manchester was 20 miles an hour, and in passing over Chat Moss, the carriages proceeded, for a time, at the rate of 27 miles!

[From the Liverpool Times.]

The steam carriages vary in their size and plan; some have two bodies and others three; some are intended to accommodate four persons in each body, and others six; and some have a central compartment, which will contain six persons, with seats before and behind, and two other compartments are in front, and one in the rear, each of them resembling a post chaise, with windows in front, and containing only three persons. The seats, which accommodate three persons each, are, at least, twice as wide as a four inside stage coach, so as to allow the same space for three as is now allotted to four. Between the sittings is a rest for the arms, and each passenger has a cushion to himself: there is also a little projection against which he may rest his head; and the backs are padded and covered with fine cloth, like a private carriage, so that the passenger may sit and sleep with as much comfort and luxury as if he were in an easy chair or on a sofa. The external appearance of the coaches is nearly equal to that of a handsome carriage. There are no outside passengers on these vehicles, and they carry no luggage; but for the ac-

commodation of both, there is a different kind of carriage, about as high as a common cart, and having four or six rows of seats, under which there are receptacles for the luggage. The passengers by these conveyances will be not nearly so elevated nor so much exposed to the danger of falling off as the outside passengers on a stage coach. It is probable that one or more of the latter vehicles will always accompany the coaches. There are also light wagons prepared for the conveyance of bales of cotton—an article of which the quantity transported will be immense.

Cements for Iron Water Pipes.

M. Gueymard, in an interesting statement of the introduction of water into the city of Grenoble, says that the mastic which he has employed to connect the pipes, has been known for some years, by the name of *Aquin*. Most of the recipes vary, and those which he had obtained directly from Vienna, Lyons, Paris, and by correspondence from London, do not answer his purpose. For this reason he commenced a series of experiments, and found the following composition, acquired the hardness and compactness of good cast iron.

I mingle ninety-eight parts of cast iron filings (pounded turnings) passed through a coarse sieve, and not oxidized, with one part of flowers of sulphur. When intimately mixed, I take one part of sal-ammoniac, and dissolve it in boiling water; and pour this solution on the preceding mixture and agitate it thoroughly. The quantity of water ought to be such as to reduce the whole to the consistency of common mortar.

This cement disengages a great quantity of heat and ammonia, and should be immediately used. It is pressed forcibly into the joints, and after drying two or three days in the open air in summer, and from seven to eight days in winter, the pipes may be covered, with an assurance of their solidity.

In all the basins or reservoirs of the city, he used only this cement, and the joints prove to be as tight as if cast iron had been melted and poured into them, or as if the cisterns were made of glass. They stand in no need of repairs.

He recommends this cement in all cases of hewn stone and other solid works exposed to the weather, as in bridges, aqueducts, conduits, &c. [*Annales des Mines.*

Queries.

A correspondent requests information on the following points.

On what descent should a rail-road be constructed, one-third of the trade being ascending, and two-thirds descending, to be used with the greatest economy of power.

What is the greatest ascent on which a locomotive will draw up four times her own weight, and the rules for calculating such ascent.